The Welding Engineer

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May, 1932

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The Welding Engineer

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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The Picture on the Cover*

The modern method of repairing or strengthening railway and highway bridges. In the case of the one it means more dividends; in the case of the other, lower taxes. On page 23 is an article which gives all the essential details on "how to do it," and cost data that is something for the bridge engineer to think about.

*Photo by courtesy of Pressler Welding Co., Chicago, Ill.

Looking Forward

in

THE WELDING ENGINEER

●

A brief description of some of the articles selected for next month's issue.

Pressure Vessels

Mr. Murphy continues his discussion of modernized pressure vessel construction, describing the equipment used to prevent costly failures and telling how it is used.

Heavy Castings

Step by step, the methods of reclaiming unserviceable equipment are explained and illustrated. Little savings grow into big savings when attention is given to small variations in the detail of such jobs.

Production of "Specials"

The job shop is not limited to the production of small articles. There are unlimited opportunities for the well equipped shop to turn out "specials" for heavy duty. Typical experiences of a large shop are related next month.

Better Work at Lower Cost

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Industry's Current Record of Welding Progress

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EDITORIAL

Modernizing for Profit

PROFITABLE operation is the chief aim and object of every business executive today, and is a goal which cannot be reached by depending upon obsolete methods of manufacturing and selling. No longer can the plant manager depend on the faithful operator to keep costs down without putting at his disposal every available scrap of new information about his work. The welder by himself is well-nigh helpless. He needs the full co-operation of his boss, preferably from a well-informed boss. Taking it by and large the welder isn't getting this co-operation to any great extent. For example, in one group of inquiries received by a welding equipment manufacturer about half were questions about how to prevent the buckling and warping in sheet and plate welding. These are simple questions. They didn't come from engineers, plant managers, superintendents, etc. They came from welders, men who sent out calls for help on things the engineers, plant managers, superintendents, etc., should know, but don't. Men who are well informed on welding procedure would be inclined to smile at the simplicity of these inquiries. Why not? Month after month the pages of this publication and many other publications in the metal working industries carry photographs of welded articles accurately fabricated, free from any trace of distortion, and often as precise in dimension as if they had been machined from solid billets. Yet here is the evidence of welders unable to deal with the phenomenon of expansion, or the result of it, distortion. It means delays, spoiled products and lost profits. The remedy is a better understanding of the welding processes on the part of the management. Modernizing should begin with the management. There is no longer any profit in "letting George do it."

Opening New Territories

IN a recent bulletin the American Institute of Steel Construction points out a special application where the use of welded construction uncovers new possibilities. In this case it is welded steel barges. The conventional reasons for welded barges, are, of course, reduced cost, reduced weight, and the elimination of leakage. It is pointed out, however, that with the new type of construction a draft of not more than six inches is possible which makes it possible for barges to go inland to points which have never heretofore been reached by water freight, and that for this reason fruit companies have been ordering a number of such barges. Of course, this is just another one of those advantages of welded construction which do not appear on the surface. Possibly a good many more of them could be uncovered by some hard digging.

Speaking of digging, a correspondent describes the construction of an all-welded plow so large that three tractors are required to pull it and four men to operate the complete outfit. It is capable of plowing a furrow 42 inches deep and three feet wide. On the surface, this too, appears to be an unnecessary magnification of the ordinary plowing operation. It happens, however, that the owner of the plow owns an immense acreage of land which at one time was fertile, but has become practically valueless because of huge deposits of sand washed over it by a flood. It is proposed to use the giant plow to get below the surface and bring the fertile soil to the top where it can be worked and made to pay a profit. Many manufacturing concerns are faced with a similar situation, fertile territories having been apparently destroyed by the flood of business reverses the past two years and presenting to the casual observer a picture of totally non-productive territory. These territories will be restored to productivity by getting down below the surface and forcing the unfavorable conditions to the top. It is not too much to predict that the welding processes will play a very important part in this rehabilitation of territories, particularly in the metal working industries.

Easing the Burden

WITH both corporations and individuals staggering under the burden of idiotic spending and ruthless draining of the public purse, it is some consolation to read news of a little response to public opinion from federal, state and local governments. Politicians seem to be on the verge of trying to think. If they can succeed even to a small extent the country will have cause for thanksgiving. The welding fraternity can give them a few ideas. It is well known that when any work on piping in public buildings is necessary the welding torch can save both materials and labor; if highway bridges are to be built or altered the welding contractor has a whole bagful of money-saving tricks; if highway building or maintenance is going on the wearing parts can be kept in service for a longer time at lower cost by hard surfacing; much of the new equipment required by public works can be made by welding cheaper than by any other way; welded tanks are generally lower in cost and more serviceable; welded buildings can be erected at less cost than riveted buildings. These are applications of the welding processes which can help to reduce government costs without impairing government efficiency. Welders can do something for the common cause and for their own tax bills by sounding off to the city fathers about these ways of saving dollars.

Spending to Save

— *is True Economy*

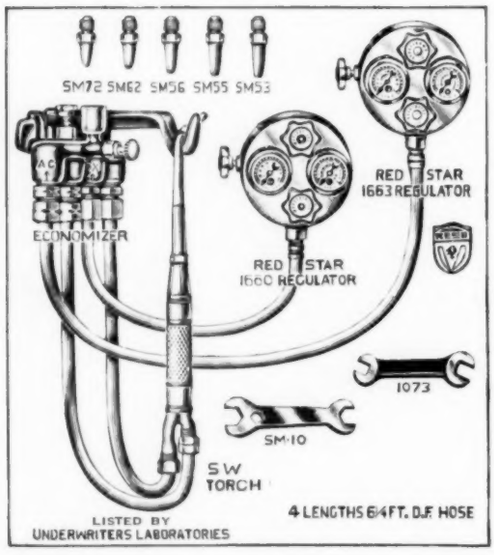
Today, when everybody is thinking about economizing, it is very easy to practice false economy. When lowered selling prices demand lowered production costs—the first thought, all too often, is to reduce expenditures to a minimum.

But when production methods are studied to determine whether by modernizing them, greater savings can be effected, it can often be demonstrated that the expenditure of a dollar now for modern equipment will result in the saving of many dollars later in production costs.

Such was the experience of the Florence Stove Company.

By making a comparatively small investment in new Rego Welding equipment and adopting

REGO Mass Production Welding Methods



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they found it possible to save several hundred dollars per month in their production costs.

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THE MONTHLY SYMPOSIUM

Pipe Welding

Service Lines

By R. T. Quick

The use of bronze welding in the installation and maintenance of gas distribution systems is considered by a large Iowa public utility as absolutely essential in securing reliable and permanent systems. This company connects service lines to mains which are under pressure by means of a specially constructed tee. This tee, shown, in Figure 1, is first fabricated with a welding torch, then bronze welded to the top of the main. The main is drilled open inside of the tee and then the tee is quickly capped. Although the cap has a screw joint it is also bronze welded to insure a leak proof joint. Using the regular welding procedure on systems under pressure is avoided because blow holes are apt to be formed when the pipe metal reached the flow point. It was found that the older method of merely welding a coupling to the side of the main made it impossible to obtain a good connection. The extreme temperature conditions encountered in

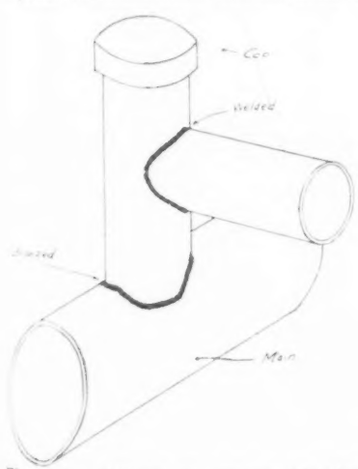


Figure 1. Method of Bronze Welding Service Connections to Lines Under Pressure.

the field made warpage of the coupling the rule rather than the exception.

The service lines to the consumers' houses are connected with recessed screw joint couplings which are bronzed to the pipe. This type of joint prevents the formation of icicles which would catch such foreign matter in the gas as tar, and eventually stop up the line.

On all old screwed pipe systems there is a large loss of gas due to leakage. Such leaks usually occur at the threaded joints of couplings which, to insure against continued leakage, are bronze welded. The old joint is heated and thoroughly cleaned with a wire brush. Then, starting at the bottom and going up around each side of the pipe, a bronze bead is deposited. The leaking gas, of course, burns during the operation and is chased up around the pipe until one fine jet is burning at the top. To stop this and seal the joint, a last drop is deposited and quickly caulked into the hole with a punch while still

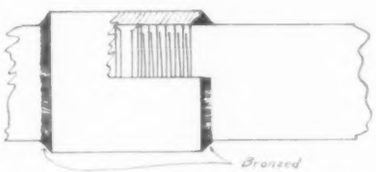


Figure 2. Bronze Prevents Leakage of Old Screw Joints.

plastic. This sort of work requires a certain skill because of the added heat of the burning gas. Unless careful, the welder will overheat the metal and have difficulty in obtaining a tight joint.

Bender

A convenient device of welded construction, and one which is especially useful around a welding shop doing considerable pipe work, is the homemade pipe bending machine shown, made entirely of scrap and old salvaged machine parts.

The machine, designed and built by the Hasty Welding Works, of San Diego, Cal., will handle any diameter pipe up to six inches and up to 20-foot lengths. It will also easily handle solid stock, angle iron, etc. A cast iron wheel taken from a salvaged harbor dredger forms the main wheel which provides the leverage and holds the pipe in bending. To this main wheel is secured a back-stop plate one inch thick by six inches wide extending to the center of the wheel. Holes are drilled in the spokes of the wheel and also in the back-stop plate for setting blocks to

Homemade Pipe Bender With Capacity Up to Six Inches.

allow for the bending of the pipe to any angle or combination of angles desired.

The machine is geared to 125,000 to 1, the revolutions of the motor being 1800 per minute, requiring one hour and fifteen minutes for one revolution of the main bending wheel. This provides much more than sufficient power for handling the heaviest job. Shop power by a take-off through an old lathe operates the device.

The Hasty Welding Works handle a great deal of pipe work in their plant, such as installations of refrigeration equipment and other equipment in large fishing boats which cruise from the San Diego harbor; and Mr. Hasty states that the use of this machine is indispensable in their work. This concern also does considerable welding in installing equipment of different kinds for the fish-canning plants in San Diego.

Protection

The problem of protecting gas main pipe which must be "pushed" across under a highway or street has been solved with rather unique methods of field fabrication by the Iowa Railway and Light Corporation. The necessity of pushing a length of pipe makes it impossible to coat and wrap it for protection against corrosion. To obviate leaving the main unprotected at this point, this company first pushes across a length of 4-inch pipe which serves as a sleeve or casing. A 4 to 3-inch reducer is welded to the 4-inch main on

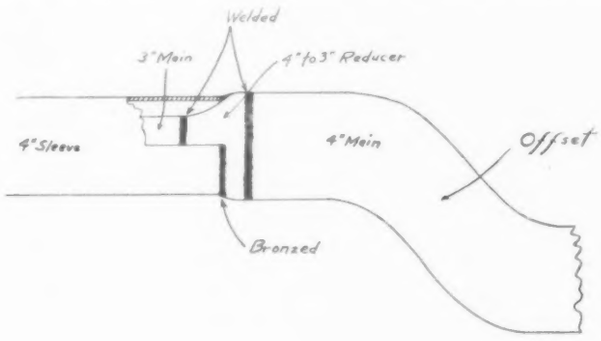


Diagram Showing How Mains Under Crossings Are Protected Against Corrosion.

one side of the street, and to a 3-inch pipe placed inside of the 4-inch sleeve. The sleeve is pushed up against the slope of the reducer and bronze welded to it as shown in the diagram. On the opposite side of the street, the sleeve is cut and split open for a short distance for accessability to the 3-inch pipe, which is then welded to a reducer and to the main as before. To complete the job, the sleeve is closed around this reducer and bronzed to it, thus providing a tight protective casing around the 3-inch main. In case the pushed pipe does not line up with the mains on both sides of the street, a short piece is heated with a torch and bent to form an offset as shown. Placing the welded joint some distance from the bend does away with the possibility of undue bending strains on the weld.

Wherever necessary to run a branch line from such a main, the 4-inch casing or sleeve is cut open, a 4-inch sleeve pushed for the branch, and a 3-inch branch line welded to the 3-inch main with a tee. To close up the casing, a 4-inch tee is cut into halves which are placed around the joint and bronzed together and to the casings.

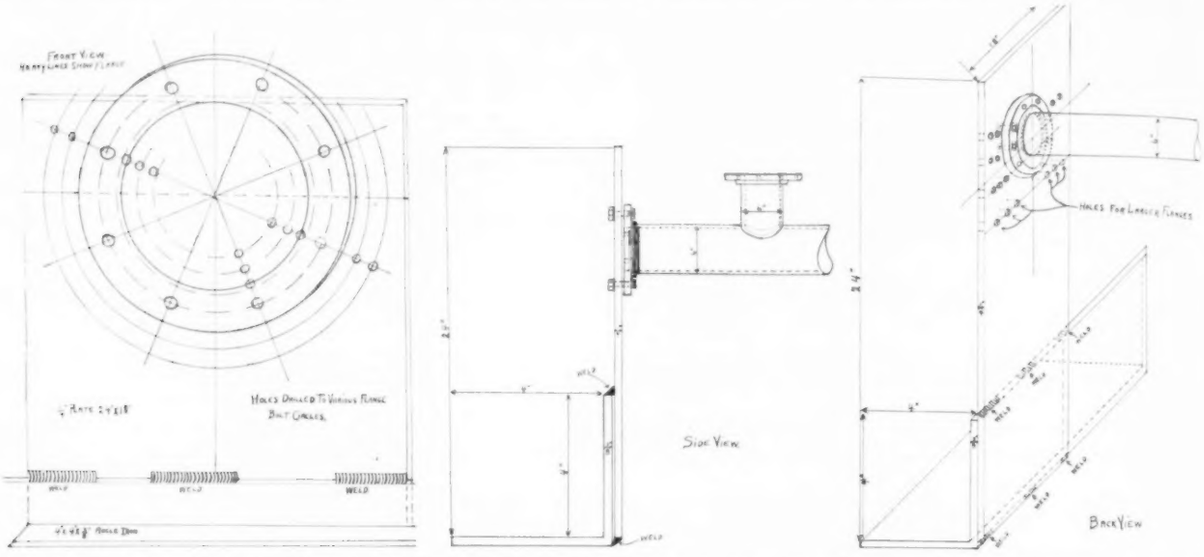
Header Jig

By George F. Walker

A jig for lining up a welded header, particularly one which is to have a number of nozzles welded on, is a time saver for the pipe welder. Where flanges are permanent it is often difficult to keep the header lined up in perfect position in vee blocks. A little vibration will throw it off line and the time taken to true it up is lost.

The accompanying sketch shows a jig for such work which will prevent this trouble. The stock required is a piece of ¼-in. plate, 18x24 inches, and a 30-inch length of 4x4x⅜-in. angle iron. These two parts are positioned as shown in the side view and tack welded in three places on the top of the flange edge and three places on the heel edge of the angle with three inches overhang on each side of the plate. Several series of bolt-hole circles are drilled in the face of the plate to accommodate various sizes of flanges.

With one of these jigs bolted to each end of the flanged end of a header, it is maintained in a rigid position as the angle iron rests on the floor or on a table with a good square bearing. Any amount of hammering or bumping will not change its position and the nozzles can be layed out, cut, fitted and welded and be perfectly true when checked. These jigs are equally useful both in the shop and on the job.



Three Views of a Jig for Keeping Pipe Headers In Alignment, Particularly When Welding in Nozzles. It is Extremely Simple to Make and a Great Time Saver.

New Applications

Plow

By W. E. Archer

A most unusual piece of agricultural equipment was recently built and placed in operation in Southern California by an ingenious farmer who knows the practical value and dependability of welded construction. This huge farming implement is a giant plow which stands nearly six feet high, four feet wide, and twenty-two feet long. Its construction was made possible for practical use to a great extent by the use of arc welding. Paul Plavan, Huntington Beach, (California) rancher, who is the designer and owner of this huge plow, states that he believes it to be the largest implement of its kind in the world,—and no one to date who has seen it has offered to dispute his claim.

This great plow is capable of plowing a furrow forty-two inches deep by thirty-six inches wide, and, when in the ground, requires three sixty-horsepower caterpillar tractors operating in low gear to pull it. Approximately two hundred gallons of gasoline are consumed by the three tractors each day that the outfit is in operation. In an average day's time, the plow will turn under five acres of ground.

The reason for the designing and building of such a giant plow was for the purpose of reclaiming a wide area of excellent river bottom farming land near the town of Talbert, California, which several years ago overflowed and as a result had been covered with several inches of sand. This sand deposit on the land made it practically useless for most crops, and materially reduced the production of beans which are particularly well adapted to the original soil of this locality, the nature of which was principally peat. So, by the use of this large plow, Mr. Plavan is able to bring this peat soil back to the surface and turn the more sandy soil of the surface to the bottom of the furrow, thus in a way improving the general nature of the soil.

The total cost of this plow was about $2,500, and while the expense of operating the outfit is extremely heavy, it is believed more than justifiable considering the great benefits expected to result from its use.

A crew of four men are required to run the outfit,—one for each tractor, and one for the plow itself. The plow is raised and lowered from and into

the ground by means of a specially constructed hydraulic lift, which also is of part-welded construction. The cylinder of this hydraulic lift is easily seen in

This Welded Plow Will Reclaim Waste Lands.

the picture at the rear over the main frame of the plow.

The construction of some of the parts for this plow were procured by special order such as the mouldboard, which is about five feet long, and which was specially shaped and machined in a Los Angeles shop. The share is forty-two inches long. By the use of welding, the plow was given the great strength needed at the points of excessive strain which were determined by repeated experiments. The implement was built by Roy E. Wise, welding shop owner and manufacturer of agricultural implements and other farm tools and equipment, of Talbert, California.

Piling

The driving of a good length of welded steel pipe piling furnishes a striking demonstration of the strength of a properly made oxy-acetylene weld. This application of the process is well described in an article in the February, 1932, issue of *Oxy-Acetylene Tips*. Here it is pointed out that the construction of solid piles to support foundations is necessary in many locations where bed rock lies much deeper than the foundation itself. One method of constructing such piles is to drive the necessary length of medium diameter pipe, then blow out the earth that is inside the pipe, and finally fill the pile with concrete. It sometimes happens that the bed rock lies deeper than the single lengths of available pipe will reach, which means that two or more lengths must be joined in such a manner that the joint will stand as much punishment from the pile driver as the pipe itself. The oxy-acetylene welding process has demonstrated its efficiency for such applications. It is stated that on one recent construction job, 250 piles in groups of two, three, four and five pipes and ranging in depth of from 25 to 69 feet were required. Sixteen-inch diameter steel pipe with 3/8-inch walls was bought in random lengths and a pipe dealer had to deliver it to the job ready for driving. It was decided to use the recently developed Lindeweld process for joining short lengths into the longer lengths required for the piling. An oxy-acetylene cutter was employed on the location to cut off short end in order that exact measurements could be had.

Since the pile driver itself in this case would handle pipe lengths only up to 35 feet, it was necessary where 50 and 60-foot piles were required to drive in short lengths of pipe at first. A short, hollow, connecting wedge, shaped like a barrel was used as a connection for starting the longer sections. Then the steam hammer drove the pile down through the earth to the rock, and the earth inside of it was removed by blowing it out.

Ice

An unusual device which is attracting considerable attention throughout the country where it is being installed is this practically all welded automatic self-operating ice vending machine. A dime and a nickel dropped in a slot at the corner of the vender puts the mechanism in motion which immediately releases and delivers a 25-pound paper-wrapped cake of ice at the front platform at the lower corner. Replenishing the machine is done at the upper door.

Delivery of the cake of ice is by means of a welded spiral conveyor or shute, constructed of light steel plate supported and strengthened by the use of two-inch channel iron, specially shaped and welded in place. Wooden rollers with steel shafts facilitate smoothness in operation.

The temperature in the vending machine is maintained at a point well below freezing by means of a refrigerating unit using the methol chloride system of cooling, with an all-welded hookup arrangement with an electric motor. This motor also controls, by means of an electrically-wound clock, the turning on and off of the night electric display lights at the proper hours each night and morning. These hookup features are also all welded.

These ice-vending devices are being built under patent rights by the Booth Engineering Company, of Los Angeles, Cal., and are being placed in operation on street corners, in markets, gasoline service stations, etc., throughout the Los Angeles district and nearby outlying territory.

In this connection, a special machine

Ice When You Want It from a Welded Dispenser.

has been designed and developed by the Central Ice & Cold Storage Company, of Los Angeles, which automatically cuts the ice into the uniform 25-pound pieces, wrapping and sealing each cake with heavy paper. This company services the vending machines in this district.

Production and Fabrication

Pedestals

The Welded Products Company of Bell, California, is manufacturing grinder pedestals of arc welded construction. The photograph shows one of the finished pedestals together with two of the main disassembled parts. The base of the pedestal is one-half-inch steel plate. Fabrication of the base is by heating and pressing to shape by hydraulic pressure, and then electrically welding to the pedestal, which is of 3/4-inch plate. The plate of which the pedestal leg is made is shaped by bending to channel shape, the two sections set together and welded, forming the square shape of the leg of the pedestal. The top is of 3/8-inch plate and is likewise welded.

The Welded Products Company has this article on full production. The parts for the products are all cut by an

This Pedestal for Grinders is a Profitable Job.

Oxygraph. A gang torch is used extensively in cutting these parts, several torches working simultaneously to speed up production.

Homes

The substitution of steel for lumber in constructing the framework of dwellings, even small ones, has been introduced on the Pacific Coast, a large portion of the construction of which is by welding. A great future development of this type of construction is freely predicted by Monti Hicks, architect and builder of Los Angeles, who recently superintended the building of a large number of these steel frame houses in the East for McClintic-Marshall Construction Co. Mr. Hicks has just finished a steel frame house in Moreno Heights, (near Los Angeles) in which welding was employed extensively.

The local plant of the Consolidated Steel Company, at Torrance is equipped

New Type of Home Which Lends Itself to Welded Steel Construction.

to furnish material in the shape of L-beams prepared either for bolting or welding, in any lengths desired. It is also possible to obtain whole sections of walls, with window and door frames welded in, in accordance with the architect's plans, and ready for erection. These sections may weigh up to 250 pounds, which is considered the limit for effective handling. To make the fireproof feature of a steel constructed dwelling complete, welded steel floor plates can be used.

While the use of steel in domestic architecture is yet in the early stages of development, it is well to bear in mind that its use does not limit the scope of design, as these frames are now being made in a local mill and can be had in any size. They make possible larger interior openings, and impart a strength of construction that permits a free spacing of doors and windows, independent of structural considerations. Its well-known rigid strength and fireproof qualities commend the use of steel to those wishing to build secure homes, and its extra expense, while an addition of about ten per cent to the cost of the whole house, is offset by a reduction in insurance premiums. Some owners of steel-framed homes do not consider ordinary fire or earthquake insurance necessary.

In the construction of one of these steel frame dwellings, mostly unskilled labor may be employed. With the aid of one or two experienced welders, the owner of a lot may purchase the steel for his house, and erect it at leisure, following directions on the plans, and the markings on the pieces.

Derrick

An all welded standard derrick is now being put on the market by R. G. Le Tourneau, Inc., Stockton, Cal. It is built especially for contractors to use in laying heavy concrete or steel pipe, and loading and unloading heavy equipment on construction work. It can lift up 10,000 pounds. The derrick has all the advantages of all steel elec-

Light in Weight Because of Welding. Yet Fast and Strong.

tric welded equipment, yet is light and very fast which is a big factor. The boom can be removed from sub frame in a few minutes by drawing two hinge pins, and the entire sub frame can be removed from caterpillars by removing six bolts.

Tanks and Containers

Pressure Vessels

A pressure vessel 6 ft. long, 3 ft. in diameter, designed for a working pressure of 150 lbs. per square inch, was recently completed by Van Schaack Bros. Chemical Works, Chicago. The shell plate was ½ in. steel and the heads ⅝ in. thick steel. The edges were bevelled for welding on one side only. The openings are one 2½ in. pipe and one 4 in. pipe in the head with the manhole in it and a 6 in. pipe opening in the side.

This vessel was welded with a shielded arc type electrode using 250 to 275 amperes and reverse polarity with a ¼ in. rod. Beads were laid down in three passes in rather thin layers, the first layer being the heaviest, while the next two were from ⅛ to 3/16 in. thick. The longitudinal seam was first tacked about every foot with welds about 1½ in. long. The first bead was then laid down, making the welds as long as the rod lasted. When one rod was deposited, another section was started back away from the first a distance of about 8 in. so that the weld always started on cold metal, decreasing the chance of setting up strains. When the end of a seam was reached, there was a series of welds about 8 in. long spaced at intervals of 8 in. These spaces were then welded up in the same order as the first set. The second bead was practically the same as the first, and the last bead, which consisted of hardly more than reinforcement, was laid on by back-stepping about 8 in. and welding up to the previous bead. When finished there was no noticeable distortion. The circumferential seam was tacked at intervals of about a foot with tacks 1½ in. long and welding proceeded in the same fashion as in the case of the longitudinal seam.

The vessel was tested according to the A. S. M. E. Code for Unfired Pressure Vessels in Class 2. The vessel was tested at 225 lbs. to the square inch and

Two Views of Welded Pressure Vessel Tested Under New A. S. M. E. Code Requirements. No Leaks Developed.

then hammered vigorously near the seams. Then the pressure was raised to 450 lbs. per square inch and held for about five minutes. During the testing period no leaks developed, the seams remaining perfectly dry all the time and showing no signs of distress.

"Bottled Gas"

The welding of high pressure containers for so-called "bottled gas" is being developed by the Shockey Boiler Works, of San Diego, California. This gas, thus "bottled", is used in outlying districts and remote settlements for domestic use where natural or artificial gas is not available, and is proving quite practical for similar use on small boats cruising from the Southern California harbors.

These tanks have a working pressure of about 85 pounds, and are tested on final completion to 390 pounds. The

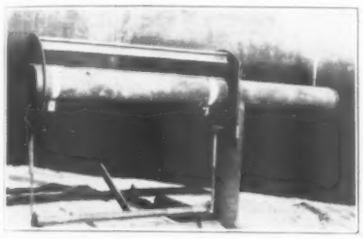


Figure 1. Scrap Iron Jig Used for Making "Bottled Gas" Tanks.

tanks are 46½ inches high, (over all) twelve inches in diameter, and are made of No. 10 gauge Class "A" tank metal. All seams are hand welded by the shielded arc method, using ⅛-inch coated rods. The heads and bottoms have 1⅛-inch welding flanges. There are nine feet of seam welding on each of these tanks, which includes the welding of the protecting bands at the top and bottom, and two bosses which are built up on the head plate for the safety plugs.

In preparing the tanks for welding, six tack welds are made on the circumferential seams on the heads and bottoms, and two (one at each end) tack welds are made on the longitudinal seam in the clamp which holds the plate edges in place. All of the welding, including tacking, on one of these tanks is completed in less than one hour, which is considered good speed for hand work.

Two homemade devices made by the Shockey Boiler Works are used to speed up the work. Fig. 1 is a jig for holding the tank metal in place for welding. This jig is made of ordinary scrap pipe, etc., and two pieces of street railway track. The main longitudinal piece of pipe over which the tank is placed for welding the longitudinal seam, is six inches in diameter. On the top side of this pipe is clamped a strip of copper plate which functions as a "back-up" plate in making the weld. This prevents the arc from burning through and leaves a smooth inside surface at the welded seam.

The main supporting column of the jig is also of six-inch pipe, which is welded to cross pieces of old two-inch boiler tubing for a base. The clamp feature of the jig which holds the edges of the plate in properly-spaced position for the longitudinal weld, is by a cleverly devised arrangement hooked up with a hand lever for its operation. The top of this clamp which contacts with the plate edges to be welded, is of two pieces of light railroad iron (the edges of which are smooth and regular) welded close together, the open space of which comes directly over the seam as the clamp is brought down over the plate edges.

Figure 2 is the preliminary testing device. The test is made by air pressure. By applying a moderate pressure of air and then painting the seams with soapsuds, small leaks, if any, can readily be detected, before the final test is made. The final test is made by hydraulic pressure.

For the frame of this preliminary testing device, an old welded welding horse placed on end was pressed into service, and serves the purpose quite satisfactorily. Across the two bottom legs of the horse is welded a piece of four-inch channel iron which serves as the base supporting the valve arrangement for turning the air into the tank. Two rods with a top crosspiece of angle iron and a hand lever arrangement, serve as a clamp for holding the tank head tight against the gasket for making the test. Note air pressure gauge at the left of the tank head.

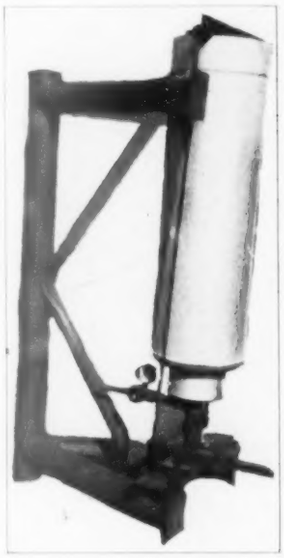


Figure 2. Ingenious Method of Testing Makes Use of an Old Welding Horse.

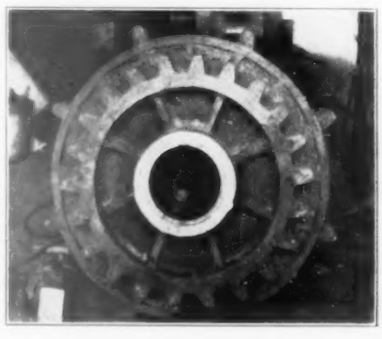
Mr. Shockey has been on production with these tanks for the past several weeks, furnishing quantities to all parts of Southern California. He expects to procure specifications for Inter-State requirements in the near future, and will then apply for a permit and start making shipments into Arizona and other states.

Maintenance Welding

Roller Teeth

A large power shovel, engaged in construction work outside of Whitehall, N. Y., was rendered temporarily useless when the teeth on its rollers became worn to knife-like edges. The problem that confronted the contractors was to find the quickest and most economical means of putting the shovel back into service. To purchase new rollers would entail an expenditure of several hundred dollars, inasmuch as each new roller would cost in the neighborhood of one hundred and fifty dollars. In addition to the purchase price of the new rollers, the contractors were faced with the possibility of having construction work held up for an indefinite period while the rollers were in the process of shipment from the manufacturer.

It was decided to accept bids from welding concerns and following this procedure the contract for the job was let to the M. Friedmann Welding Co., Schenectady, N. Y. Three days after the rollers arrived in the welding shop, the teeth had been built up through the use of General Electric arc-welding equipments and type L electrode, and the rollers were back in service. Before welding, the rollers weighed approximately seven hundred and fifty pounds each. When they left the shop they weighed nearly eight hundred pounds apiece, it being estimated that



Fifty Pounds of Weld Metal Reclaim These Power Shovel Teeth.

fifty pounds of metal was added to each roller at a welding cost of approximately ten dollars per roller.

Gear Teeth

By S. H. Jones†

In arranging for a gear tooth job, it is best to support the gear with a pipe or shaft upon which it will turn. After having made proper selections of filler material and flux, light the torch and adjust a neutral flame, which is very important in all operations. Assuming the tooth has broken flush with the body of the gear begin by heating this immediate section to the fusion point, then holding the torch at an angle to the work, proceed with the application by first applying flux to remove the oxide scale and float out such impurities as may be encountered. You should start at one side of the gear and build to the other a very narrow bead that has been well fused and free from blow holes.

In the case of narrow gears, allow a few moments for the metal to chill, then repeat the operation, being careful to maintain a narrow deposit. Don't consider the size of the bead so far as the finish is concerned as that is to be another operation. As the tooth is taking form and gaining height it will be noticed that the ends or points are becoming round and the tooth is much shorter. This must be corrected, and it is done by holding the torch at just the angle that will bring the surface to the fusion point and at this moment have the filler rod ready for a deposit of metal.

Now in the building of edges and points the customary procedure of removing the filler rod before the flame is changed, and this time the flame is quickly removed and then slowly and cautiously the rod is removed. This method will enable you to build the gear tooth to the desired length or square up a corner. The height may be checked by the adjacent tooth or with a gauge that might be fashioned for such work. Having the height and length now consider the finish of the sides of the tooth. This is where the wear will be and it must be made as nearly perfect as possible. We now take advantage of our first arrangement, that of being able to turn the gear to any desired position.

Again emphasis is given to torch manipulation. We find there are high and low places that must be put into proper shape and care must be exercised not to overheat and cause distortion. It will be found best to apply heat near the base of the tooth and work out the high and low spots, flowing the metal in the desired alignment, and where necessary striking off the excess metal with a cold rod. To square the ends of the teeth treat them in like manner.

There are other classes of cast iron gear work to which this method will not apply. For example, where the tooth is too small to permit proper finish with the torch, and in this case we resort to bronze. In this work do not fuse the metals but heat the base material until the bronze will adhere to the surface. In welding it is *good* practice to clean the surface but in brazing it is *absolutely necessary*. One should never allow anything to come in contact with the prepared surface prior to brazing, since the mere touch of a finger may add serious difficulty to the work. Torch manipulation is very similar to that used in building a welded tooth except that the entire section between the good teeth is filled in with bronze, and the new work is formed with a hack saw and file or with proper machine tool.

In connection with the subject of cast iron let me suggest a simple method of holding small and odd shaped articles such as have been classed as impracticable to weld, because of the time involved and the difficulty of obtaining proper alignment and setting the work.

Procure two bushels of moulders' sand and place it in a suitable container on the welding bench; with the sand so placed you have solved future troubles in holding odd shaped machine parts. All you have to do now is to hold the broken parts firmly in your hand while sinking them into the sand. You will be agreeably surprised at the saving of time and worry that has been so effected.

*Extract from a paper "Oxy-Acetylene in the Textile Industry" read before the Second Annual Welding Conference, Georgia School of Technology, Atlanta, Ga., Jan. 27, 28, 1932.

†Burdett Oxygen Co., Atlanta, Ga.

Savings

The welding department of the Richfield Oil Company in the Signal Hill field of Southern California handle a wide variety of welding jobs for both the production and refining division of that company. Thousands of dollars are saved for the company each month by this department in repairing expensive drilling and refinery equipment.

A small example of the saving effected by some of these jobs is illustrated by welding two breaks in a large Fairbanks, Morse pump used for pumping waste water from the "slush pond" in oil well drilling. The breaks are in the water end of the pump. (Fig. 1). One break was a large crack at the outer portion of the pump extending about eight inches down the corner, and broken entirely through to the inside. The second break was the inner rib, or partition, between the valve seats, (intake and discharge) which was broken loose all the way through and the entire length of the rib.

This was a combination job employing two processes of welding, the break at the outer corner was repaired by acetylene brazing, while the inner rib was electrically welded. The brazing job was done without preheating, a feature of importance as the job was a rush one where time represented money. The crack was prepared for brazing by merely grinding out to a 45 degree bevel and then commencing at the bottom of the break and working upward to the top. Figure 2 shows the brazing job just after it was completed. The time required for this part of the job was only about 20 minutes, using a quarter-inch rod.

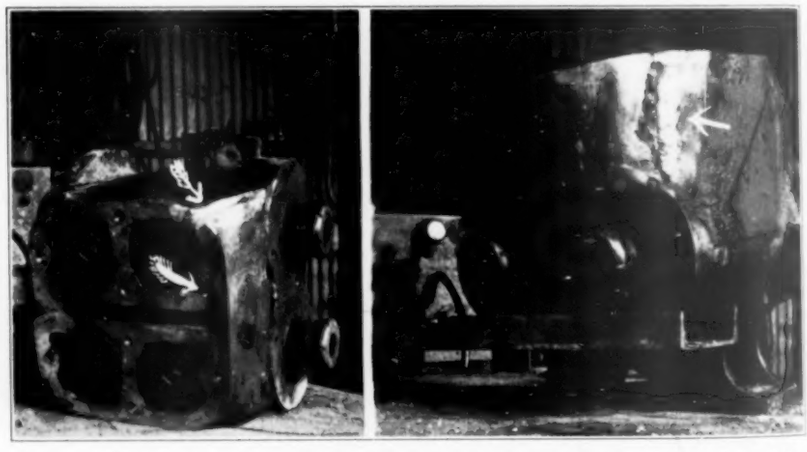


Figure 1. (Left.) View of the Casting Prepared for Welding. Arrows Indicate Breaks. Figure 2. (Right.) The Completed Brazing Job.

The inner rib job, which was electrically welded, required only about ten minutes to finish, and was done with a ⅛-inch rod.

The total cost of the welding on this job did not exceed $2.00, and saved the oil company approximately $100, the cost of a new pump end.

Reduced Cost of Bridge Maintenance*

By Frank P. McKibben†

When bridges wear out or when loads increase huge appropriations are necessary for repair or strengthening. Competent welding engineers can slash these appropriations down to a third of the cost of a riveted job and maintain traffic while the work is in progress. Several successful methods are shown here.

PREVIOUS to the transition period approximating the years 1885-1890, the principal metal used in metallic bridges was wrought iron; but since that time, practically all metallic highway and railway bridges, have been made of steel. Steel was first used in the Eads Bridge at St. Louis in the early seventies, but this was very unusual.

So far as the present study is concerned, wrought iron is pure iron. The amounts of carbon, silicon, sulphur and manganese contained therein are negligible; but introduction into the iron of very small amounts of these elements produced steel, and resulted in one-third to one-half greater tensile strengths. Changes in manufacturing methods lowered costs of production. So that by 1890, soft or medium steel containing approximately 0.15 per cent carbon came into general use for structural work. In recent years, copper-bearing and other alloy steels, such as those containing nickel or silicon, are coming into use.

Of the many wrought iron bridges and early steel bridges in service at present, some are now inadequate because of corrosion or because of great increases in loads to which they are subjected. In 1885 a loaded wagon weighing five or six tons was considered a reasonable live load for use in proportioning highway bridges not subjected to electric cars. In 1930, the writer used thirty-ton trucks in designing the floor system of a large bridge in a city where twenty-ton loaded trucks were then in service. Thus have the loads increased.

In many cases, these highway or railroad bridges can be given a very considerably increased longevity by repairing or reinforcing with the aid of welding.

Causes Which Necessitate Alterations

The influences which cause alterations may be thus classified:

1. Corrosion.
2. Cracks due to overloading or to defective metal.
3. Excessive stresses.

Corrosion. Wrought iron bridges seldom become in-

*From a paper read before the American Road Builders' Association, January, 1932.

†Consulting Engineer, General Electric Co., Black Gap, Pa.

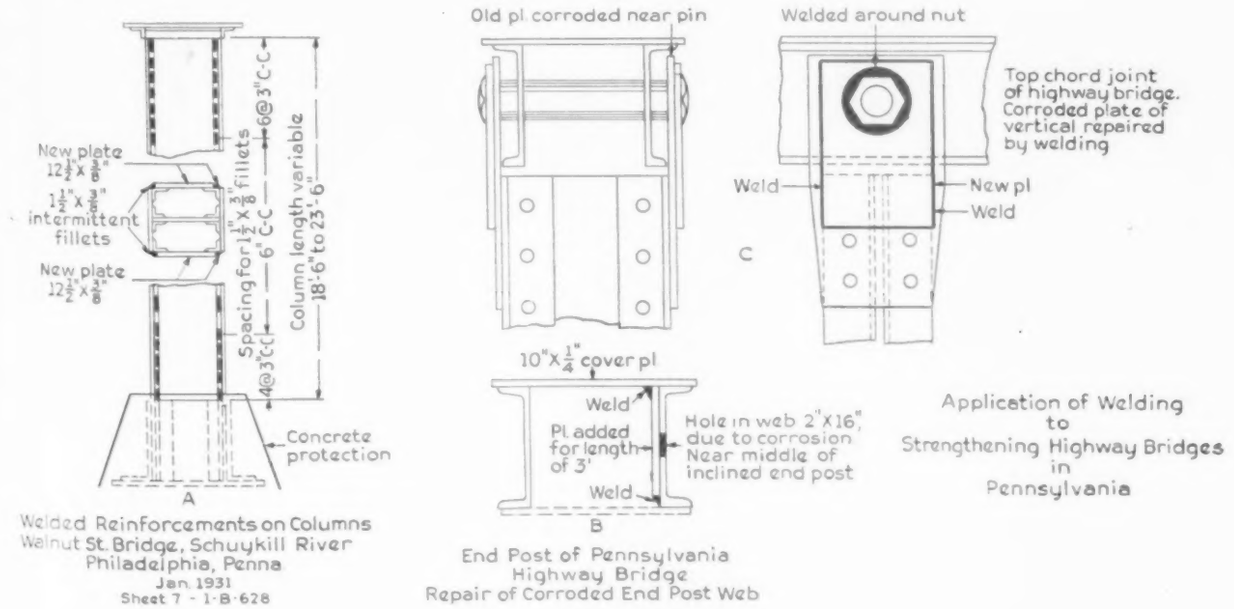

New plate 12½"X⅜"
1½"X⅜" intermittent fillets
New plate 12½"X⅜"
Spacing for 1½" X ⅜" fillets 6" C-C
4@3" c-c
6@3" C-C
Column length variable 18'-6" to 23'-6"
Concrete protection
A
Welded Reinforcements on Columns
Walnut St. Bridge, Schuykill River
Philadelphia, Penna
Jan. 1931
Sheet 7 - 1-B-628
Old pl. corroded near pin
10"X¼" cover pl
Weld
Pl. added for length of 3'
Weld
Hole in web 2"X16", due to corrosion Near middle of inclined end post
B
End Post of Pennsylvania Highway Bridge
Repair of Corroded End Post Web
Welded around nut
Top chord joint of highway bridge. Corroded plate of vertical repaired by welding
Weld
New pl
Weld
C
Application of Welding to Strengthening Highway Bridges in Pennsylvania

Fig 1

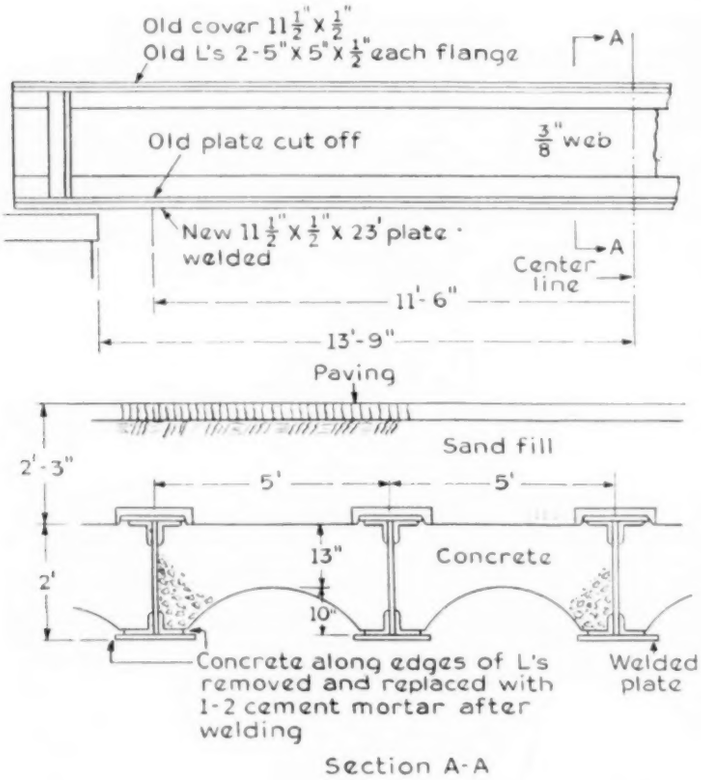
Reinforcing a Channel Web of a Truss End-Post Where Corrosion Had Caused a 2-In. x 16-In. Hole in the Web.

adequate because of corrosion, but steel bridges frequently suffer from this influence. Rust on wrought iron takes the form of small spherical particles, easily brushed off; whereas on steel, it appears in large sheets or laminations of oxides, sometimes as thick as ¼-inch. And as this deterioration is usually localized,—as for example at supports where the metal is in contact with earth, at points where wooden floors cover steel stringers or floor beams, at places where planking is in contact with or close to girders or truss members, or at contact points between concrete and steel,—the addition of new material welded in place is efficacious.

Figure 1B, illustrates a simple use of welding to add a new plate to an inclined end post of a highway bridge in Pennsylvania where corrosion had formed a hole 2 in. by 16 in. in a channel web. A short reinforcing plate was placed inside of the post and welded to the channel.

One of the most interesting applications of welding to replace corroded metal is that of the New York Central Railroad's overhead highway bridge M-4-A, at Brook Avenue, Borough of Bronx, New York City, Fig. 2. This structure, as well as Bridges M-1 at E. 163rd St., and M-8 at E. 149th St., had exposed girder lower flange plates badly corroded by gases from locomotives passing underneath. The old flange plates were removed, a few at a time; the old steel was thoroughly cleaned, and old exposed rivet shanks chipped off; then new flange plates were welded in place of the old ones without appreciably disturbing the concrete arches in contact with the girders, except insofar as necessary to provide places for clamps. But as the dead load stresses in the bottom flanges were large, it was necessary in applying the new plates to give them an initial dead load stress comparable with that in the bottom flange angles from which the corroded plates were removed and to which the new plates were welded.

This transfer of stress was accomplished by first clamping the new plate to the old angles; then, with two welders operating, a 30-inch continuous fillet was deposited on each side at one end of the new plate to weld it to the angles. With the plate clamped in position and thus welded at one end, it was heated with torches until its length was increased by a predetermined calculated amount, and while subjected to this heat, the free end of the plate was welded, likewise with two 30-inch continuous welds, after which intermittent welds were placed at 3-inch intervals on each side. The cooling and consequent shortening of the plate transferred some dead load stress from the old angles to the new plate. Strain-gage readings on several plates indicated that the stress induced in the plates agreed with that desired. Clearly, this process of heating need be applied only where the unit dead load stress is large, that is, where it constitutes a large percentage of the combined dead and live load stresses.



Increase in length of flange plate :-

Due to stress = $\frac{SL}{E} = \frac{11000(23)12}{30000000} = 0.10"$

Due to temperature = DCL

$DCL = \frac{SL}{E}$

$D = \frac{S}{EC} = \frac{11000}{30000000(0.000007)} = 52°F.$

or DCL = 0.10"; $D = \frac{0.10}{0.000007(23)12} = 52°F.$

S = unit stress

L = length of plate

E = modulus of elasticity

D = degrees fahr

C = coef. of expansion

New York Central Railroad
Under Brook Ave. - Boro. of Bronx
Between E. 157th and E. 159th Streets
107 Girders Repaired by Welding

See Eng. News-record, Oct. 24, 1929
Article by H. T. Welty
Method patented by A. G. Leake

Fig 2

The increased length in inches may be easily computed by multiplying the desired unit stress in pounds per square inch by the length of the plate in inches and dividing the product by the modulus of elasticity of steel, 30,000,000.

Cracks Due to Overloading or to Defective Metal. Defects resulting from cracks are most likely to appear in structural details such as angles connecting stringers to floor beams; or top flange angles on stringers of railroad bridges which crack horizontally along the junction of

vertical and horizontal legs due to bending of the latter resulting from flexure of track ties resting directly on the angles.

Figure 3 presents a method of strengthening the outstanding legs of stringer upper flange angles by welding triangular bracket plates after the cracked material is cut out and replaced by depositing weld metal at the root of the angle. This method of adding metal to the root of angles is also applied where the angles exhibit weakness but are not cracked.

Excessive Stresses Due to Overloading. Increases in weights of vehicular traffic on highway bridges and of locomotives on railway bridges constitute the most common cause of strengthening wrought iron or steel bridges. And generally this inadequacy manifests itself in the floor system, although trusses are sometimes light for the duty imposed on them.

One of the best illustrations of reinforcing bridges, too light for present day traffic, is that of the Chicago Great Western Railway's Missouri River Bridge, Leavenworth, Kan., consisting of one 440 ft. through draw and two 330 ft. through fixed spans, designed by George S. Morrison, and built in 1893, Fig. 4. Adequate for the live load of 3000 lb. per linear foot for which designed, the structure had to be reinforced or rebuilt to accommodate heavy

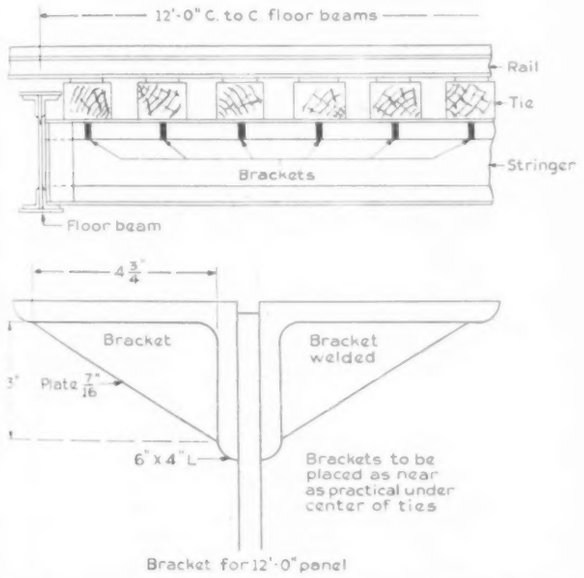


Figure 3. **Method of Strengthening Outstanding Legs of Stringer Upper Flange Angles.**

current traffic. Between the dates of February 28th and April 28th, 1927, 225,000 lb. of structural steel reinforcing, involving the use of 2000 lb. of welding wire to deposit 7,500 linear ft. of welding, were applied without interruption to the heavy traffic of the three railroads using the bridge. This strengthening provided for a single locomotive with 55,000 lb. on each pair of drivers, followed by a uniform train load of 4,000 lb. per linear ft. Fig. 4, showing the welded details, indicates that additional plates were welded to top chords and end posts of fixed spans, to bottom flanges of all stringers, to top and bottom flanges of all floor beams; and that changes were also made in top flanges of all stringers and in parts of the lateral system.

The addition of a narrow plate to the top, and of a wide plate of the lower flange of floor beam is the arrangement frequently used, and is desirable in that it permits downward (horizontal) welding and avoids overhead welding. The same procedure is illustrated in Fig. 5 noting several other Chicago Great Western Railway bridges, and in Fig. 6 which illustrates floor beams on a Pennsylvania Highway Department bridge strengthened in the same manner.

Fig. 6 also sets forth a clever method for raising, by means of jacks, the existing stringers and planking in order to replace the upper flange reinforcing plate on the floor beam and to insert nine lines of new stringers.

Welding Solves Many Problems

Wrought iron or low carbon steel of which the older metallic bridges are built are easily welded. Welding is used in cases similar to those described in this paper because it results in economies. In general, it is by far the cheapest and best method available.

If arc-welding is used, the proper current may be supplied by a generator driven by an electric motor if electric power is available or by a gas engine if no electric line is at hand. For hand-welding wrought iron or low carbon structural steel, using a $\frac{5}{32}$-in. bare wire electrode, the amperage should be about 160 to 180 when depositing $\frac{1}{4}$-in. to $\frac{3}{8}$-in. fillets on steel of $\frac{1}{4}$-in. to $\frac{3}{8}$-in. thickness; the lesser current for the smaller, and the greater for the larger fillets and thicknesses.

If bare electrodes are used their chemical composition should be approximately as follows: carbon, 0.13 to 0.18 percent; manganese 0.40 to 0.60 percent; phosphorus and sulphur not over 0.04 percent each; silicon not over 0.06 percent. In general the work to be welded should be the positive, and the electrode the negative side of the circuit.

Corroded iron or steel should be cleaned of dirt, rust and paint before welding is applied; and if corrosion has proceeded to the point of leaving thin edges on angles or other similar parts, the thin portions should be removed till adequate thickness is reached whereon welding may be applied. Care should be exercised to secure good penetration of the weld metal into the parts welded.

Not infrequently one sees plates welded to flanges of stringers or floor beams with intermittent fillets. As this arrangement permits water to enter between the reinforcing plate and the original flange parts, continuous instead of intermittent welding seems preferable, and not very much more costly.

Qualification of Welders

As only capable welders should be employed on important undertakings, all applicants should be tested at the beginning of the work to ascertain their fitness; and, if the project be of sufficient magnitude to warrant, those employed should also be tested at intervals during the progress of the work. The qualification tests for determining their competency are well standardized by the American Welding Society.

The writer's list of welded structures includes 75 bridges in which welding has been used during the last four years to reinforce or alter existing bridges, but doubtless there are many others. On the whole, railroad companies have been much more favorably inclined toward the use of welding than have state highway departments, although several of the latter have become very

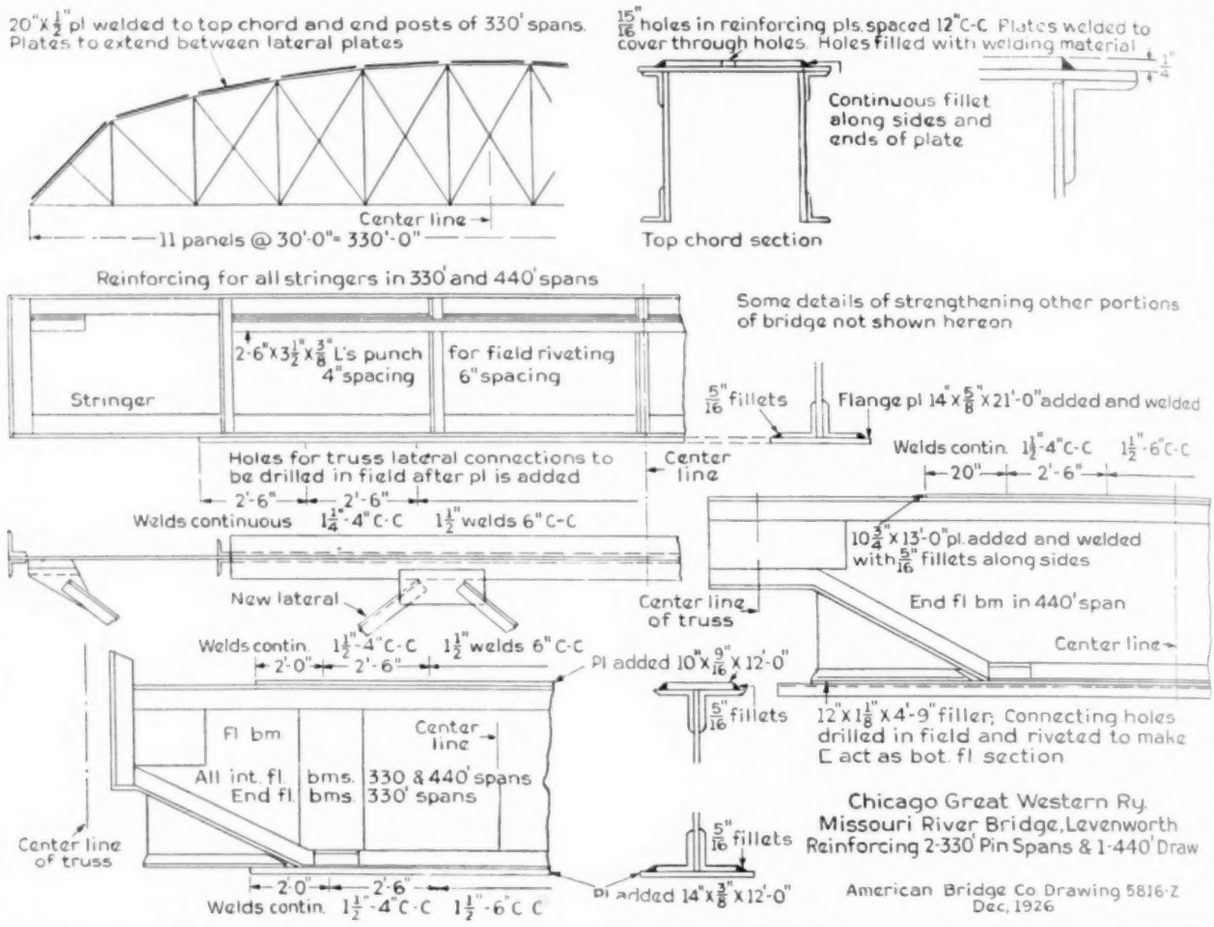
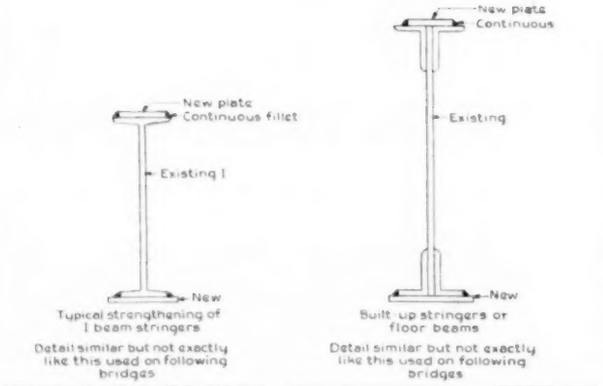

20"x½" pl welded to top chord and end posts of 330' spans. Plates to extend between lateral plates
Center line
11 panels @ 30'-0" = 330'-0"
15/16" holes in reinforcing pls. spaced 12"C-C. Plates welded to cover through holes. Holes filled with welding material
Continuous fillet along sides and ends of plate
Top chord section
Reinforcing for all stringers in 330' and 440' spans
Stringer
2-6"x3½"x⅜" L's punch 4" spacing
for field riveting 6" spacing
Some details of strengthening other portions of bridge not shown hereon
5/16" fillets
Flange pl 14"x⅝"x21'-0" added and welded
Welds contin. 1½"-4"C-C 1½"-6"C-C
Holes for truss lateral connections to be drilled in field after pl is added
Center line
20" 2'-6"
2'-6" 2'-6"
Welds continuous 1¼"-4"C-C 1½" welds 6"C-C
10¾"x13'-0" pl. added and welded with 5/16" fillets along sides
New lateral
Center line of truss
End fl bm in 440' span
Center line
Welds contin. 1½"-4"C-C 1½" welds 6"C-C
2'-0" 2'-6"
Pl added 10"x9/16"x12'-0"
5/16" fillets
12"x1⅛"x4'-9" filler; Connecting holes drilled in field and riveted to make C act as bot. fl section
Fl bm
Center line
All int. fl. bms. 330 & 440' spans
End fl. bms. 330' spans
Center line of truss
5/16" fillets
Chicago Great Western Ry.
Missouri River Bridge, Levenworth
Reinforcing 2-330' Pin Spans & 1-440' Draw
2'-0" 2'-6"
Welds contin. 1½"-4"C-C 1½"-6"C C
Pl added 14"x⅜"x12'-0"
American Bridge Co. Drawing 5816-Z
Dec, 1926

Figure 4. Method of Reinforcing a Bridge, Too Light for Present-Day Traffic.



Bridge Number	Location	Number of str. or fl. bm. altered
F 136	3 mi. N. Marshalltown	48 str.
F 425	1½ mi. N. Ravenhood	4 str.
F 426	1½ mi. N. Ravenhood	2 str.
F 449	1¼ mi. S. Guilford	8 str.

Chicago Great Western Ry. Bridges Strengthened by Welding

Bridge Number	Location	Number of str. or fl. bm. altered
F 98	½ mi. N. Gladbrook, Iowa	15 fl. bm.
F 136	3 mi. N. Marshalltown, Iowa	28 fl. bm.
F 140	2 mi. S. Marshalltown, Iowa	5 fl. bm.
F 408	2 mi. N. Sheridan, Mo.	10 fl. bm.
F 425	1½ mi. N. Ravenhood, Mo.	17 fl. bm.
F 426	1½ mi. N. Ravenhood, Mo.	16 fl. bm.
F 449	1¼ mi. S. Guilford, Mo.	18 fl. bm.
F 267	Des Moines, Iowa	24 fl. bm.
F 267	Des Moines, Iowa	56 str.

Figure 5. Plates Welded on Top and Bottom Afford Strength and Ease of Welding.

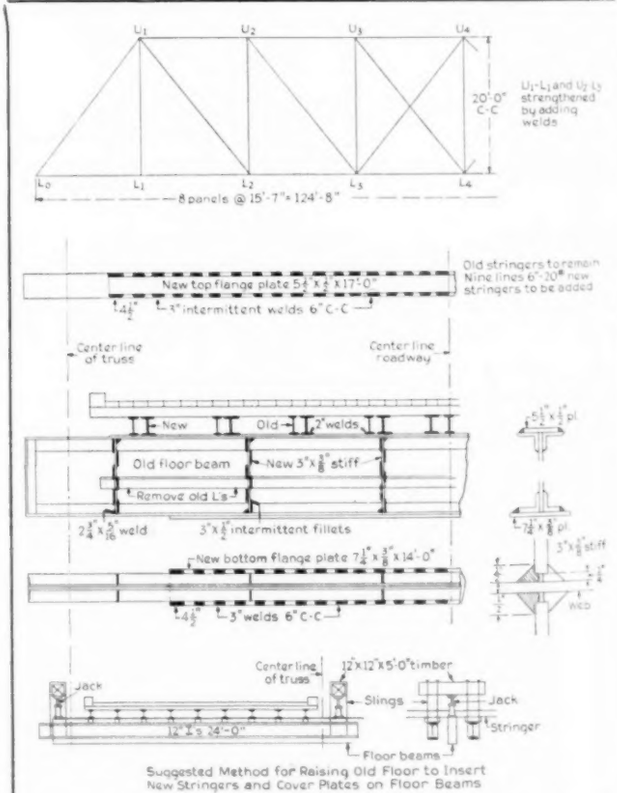


Figure 6. Method Similar to Figure 5 Used in Strengthening a Highway Bridge.

active during the past year in applying this modern tool to those cases where applicable.

Certainly welding will not solve all the structural engineer's problems, but many opportunities arise in altering wrought iron or steel highway or railway bridges where no other method is so well adapted.

Data on Strengthening C. G. W. Bridge at Des Moines, Iowa

By Walter Roof†

IN bridge strengthening and repair the time element is important; traffic delay must be reduced to a minimum, and expenditures limited. Such a situation faced the Bridge Department of the Chicago Great Western early in the spring of 1930 when new heavy power was purchased for operation on the Illinois and Minnesota Divisions and it was desired to release the existing heavy 2-10-2, Sante Fe Type, power on these two divisions and operate them on the Iowa Division where their use was restricted. Before the released power could be permitted to operate on this Division, it was necessary to reinforce the floor system of the limiting structure, which was a large steel bridge over the Des Moines River in Des Moines, Iowa.

This bridge consists of four skew 180-foot through truss spans, single track, designed for Coopers E-42 loading and placed in service in 1902. This structure had been in service twenty-eight years, and for the past twenty years has carried traffic considerably heavier than provided for in the original design.

There are two lines of stringers spaced 6′-6″ apart, 24′-10½″ long and made up with four angles 6″x6″x$\frac{9}{16}$″ and a web 42″x½″. The floor beams are 16′ long and are made up with four angles 6″x6″x½″ and a web 48″x½″. Rivets ⅞″ diameter.

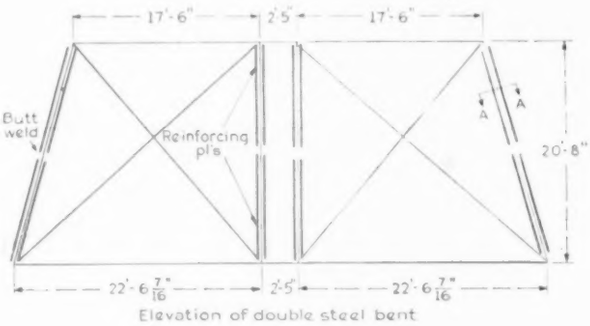
Under the loading of the locomotive in question, the stringers were stressed 24,100 pounds per square inch and the floor beams 27,100 pounds per square inch, including impact in each case. As single headed locomotives will be operated over this structure at a reduced speed, it was found that reinforcement of the trusses was unnecessary.

By welding cover plates upon both flanges of the stringers, it was possible to reduce the overstressing down to 16,800 pounds per square inch and by adding cover plates to both flanges of the intermediate floor beams, the overstressing was reduced to 17,180 pounds per square inch. The new loading is restricted to single headed trains at a reduced speed. As this bridge is located in Terminal Territory where speed must be slow, the restrictions made do not affect the economy of train operation.

The arc welding process was selected on account of being able to get the work completed on short notice; it also made it possible to get quick delivery of new steel plates which did not require fabrication. The top stringer plates are 9″x½″x23′-6″ and the bottom stringer plates are 15″x⅜x16′-0″. The top plates were made the full length so as to have uniform dapping of the bridge ties. The top floor beam plates are 9″x½″x11′-6″ and the bottom floor beam plates are 15″x⅜″x11′-6″. The end floor beams were not strengthened by the arc welding method, but were blocked up on the masonry piers and abutments at the stringer connections with heavy creosoted timbers. All of the end floor beams are skewed and would have required longer reinforcing plates and more welding than the intermediates. It was more economical to block these up.

On an average, there were three welders and three welding machines of the motor driven type delivering 85 volts D.C. at 300 amperes. A.C. electrical energy of 440 volts was available from a high transmission line 150 feet from the bridge. The welding contractor, The Pressler Welding Co., Chicago, Ill., was at the bridge site March 24 and started welding on the 25th, and completed his work on April 12th and billed out his equipment on the same day. Nineteen working days were required to perform the work, or 52 man days.

The average lineal feet of welding per man per day was 140 feet. Division forces of three bridge gangs were on hand to assist welders in placing the new reinforcing plates, cleaning the old steel, shifting the bridge deck, shifting scaffolding, cutting out rivets in the stringer flanges which interfered with the placing of the new plates and installing the creosoted blocking under the end floor beams. This required an average of 19 bridgemen or a total of 362 man days.



Elevation of double steel bent

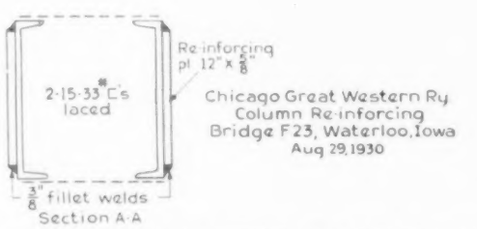


Figure 7. Welded Column Reinforcement on Waterloo, Iowa, Great Western Railway Bridge.

The stringers are 24′-10½″ long and have four panels of top lateral bracing and the bottom flange is connected to the bottom lateral bracing of the trusses. As all of this work interfered with the placing of the new plates, it was necessary to remove all of the rivet heads in the outstanding angles of the stringer flanges and afterwards to weld the old connection plates to the stringers. Even with these complications, excellent progress was made.

Downhand welding is preferable to overhead welding, on account of securing better fusion and getting greater speed. In order to eliminate overhead welding, the top reinforcing plates were made 3½ inches narrower than the original top flange width and the bottom reinforcing plates were made 2½ inches wider than the original width of the bottom flange (Fig. 5). The top plates were ½-in. thick and the bottom plates ⅜-in. and were so selected

†Bridge Engineer, Chicago Great Western Railroad.

to balance the revised flange sections. The size of the fillet weld was ⅜-in. throughout the work.

The cost of the work was as follows:

(A) Welding Work	
New Plates, 47,560 lbs.	$ 899.19
Welding, 7,212 lineal feet, Lump Sum, Contract	3,170.50
Company forces assisting	784.50
Total—Welding work proper	$4,854.19
(B) Miscellaneous work, consisting of blocking up end floor beams, painting, hardware, store and tool expense, freight and rental of equipment	1,635.51
Total Cost of All Work	$6,489.70

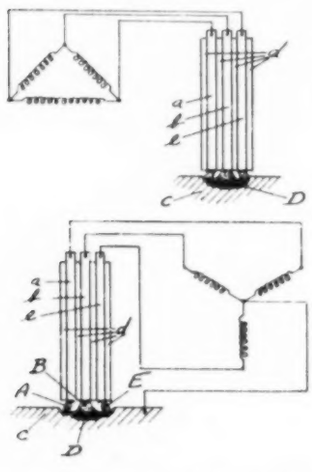
There were 24 floor beams and 56 stringers reinforced at the top and bottom flanges, requiring 6,645 lineal feet of down hand welding and 567 lineal feet of overhead welding, or a total of 7,212 lineal feet of ⅜-in. arc welding work. The average cost of the welding work proper was 67.3 cents per lineal foot.

Comment on "Methods of Controlling Arc Blow"*

By C. J. Holslog†

The old Siemund Wenzel welding handles in the period of 1912 to 1915 were equipped with ten turns of No. 10 wire in multiple with the handle in order to be able to weld overhead. They also put this claim up in the famous Enderlein-Siemund patent suit which lasted from 1910 to 1915. Their contention was the principal cause of their losing the suit because Enderlein welded overhead with a pair of pliers which ended this magnetic blow argument. Of course since then, especially on automatic work and with heavy current welding, the control of arc blow has become important.

There is one case of magnetic blow you did not investigate, that is, two arcs in series on A.C. or D.C. In this case magnetic blow is steady, it cannot change because the polarity cannot change. The blow is always repellant, but



Connection Diagram of Hook-up for Using Two or More Arcs.

it is not very much marked when the molten pool is established and is not so great but what the two puddles can be joined into one welding pool. The current in this arrangement goes down one rod, into the common puddle, across the puddle, up the other rod and the current is used twice. Two separate voltages, however, that is one for each arc, make the power demand twice that of one arc. The power factor, however, on A.C. is double at no cost and no heavier duty machine is required for this arrangement on A.C. With this series arrangement the polarities can never vary. They are always repellant and hence, steady. If they were not so, I am afraid the arc would jump across from rod to rod and not go through the puddle. The principle advantage of this Dublarc[1] is the increased speed of two and one-half to three times as much as the single arc but, of course, the work has to be heavy enough to stand it. Another big advantage is that machines which have only the current capacity of the last decade, say 300 to 400 amperes, can be brought up to do 600 to 800 amperes work by means of two arcs in series at one-half the current and twice the voltage.

*Two Articles "Methods of Controlling Arc Blow" which appeared in the March and April Issues of The Welding Engineer.

†Electric Arc Cutting and Welding Co.

[1]A system of welding controlled by patents owned by the author's company.

Gas Pressure Regulators Economically Welded

A very considerable reduction in construction and assembly costs of a gas pressure regulator unit has been made possible by the utilization of the shielded arc process of arc welding which has made such rapid strides recently.

Central Station Pressure Reducing Installation Entirely Assembled by Welding.

The unit in question is installed in the Muncie, Indiana, station of the Ohio Fuel Gas Co., to reduce the pressure on trunk lines for city use. It consists of six high pressure regulators and 12 gate valves; in the meter end there are seven merco stops and seven gate valves, as well as seven 10-inch all-welded orifice flanges. On the whole installation, shown in the accompanying illustration, are 120 all-welded steel flanges. It weighs over 40,000 pounds.

Adaptability of the shielded arc technique is shown by the variety of pipe sizes. The regulator consists of 45 feet of 16-inch, 22 feet of 12-inch, 159 feet of 10-inch, 40 feet of 8-inch, 80 feet of 6-inch, 71 feet of 3-inch, and 20 feet of 2½-inch pipe.

The Ohio Fuel Gas Co. is an extensive user of welding and is equipped with standardized arc welded jigs and fixtures for production of fittings. Flanges are cut by gas on an arc welded automatic set-up and held in position on a special fixture. All pressure welding is done with the shielded arc "Fleetweld" electrode and "Stable Arc" welders of The Lincoln Electric Co., of Cleveland, Ohio.

4,000,000,000 Cubic Feet of Gas—How to Use It Efficiently*

By H. O. T. Ridlon†

Production welding for profit at existing price levels demands close figuring by the management. Equipment must be selected to suit the work and tested by performance rather than price. Jigs save many times their cost and improve the result as well. Careful planning pays a profit by reducing the cost of gas and labor.

FOUR paramount factors in connection with production welding and cutting will be covered in this discussion.

First: Proper use of equipment and the folly of using wrong equipment.

Second: Mass production methods and the use of jigs—also the use of improper jigs.

Third: The operator—or the human element—which in many cases is sadly lacking or not considered; this possibly is the most important, because of the merchandising value or lack of it in the welded product.

Fourth: A few instances of production welding which illustrate these points.

Starting with the first division, the last census available, for 1929, on the consumption of oxygen and acetylene through welding equipment, shows that in 1929 there were consumed 3 billion feet of oxygen and nearly 1 billion cubic feet of acetylene.

A great many firms, and quite a few of the old timers, stick religiously to their old and obsolete torches and regulators—not realizing that, depending upon the use of the torch, it consumes anywhere from ten to one hundred times its value in welding gas in a year's time. This is also true of labor—which possibly runs higher.

The manufacturers of acetylene and welding equipment have made very rapid strides in the past few years, in the development of torches. One describes a welding torch as merely a couple of valves—tubes—mixing chamber—handle—tip—etc. But because of the tremendous speed of flame propagation, 330 ft. a second, these simple elements must be combined accurately, scientifically and with master craftsmanship. Your old equipment cannot give you modern efficiency for any type of welding any more than a car 10, 12 or 15 years old can give you the economical, dependable service that you demand today. Every minute wasted—every minute lost—every cubic foot of wasted gas is lost profit—and in these days of highly competitive markets, lost profits are something worthy of anyone's consideration, whether he be executive or operator.

Modern science and engineering skill have developed torches which are adaptable to every kind of work to be done; you cannot do light air craft work correctly with some heavy duty outfit any more than you can perform heavy work with an aircraft torch. Also—on production work a heavy, cumbersome torch slows up the operator—tires him unnecessarily with its weight and improper functioning. Therefore, it is vitally important that in production work the operator be supplied with a torch designed for the job he is doing.

The regulators on an outfit are the heart of the outfit itself—and unless they are modern, up-to-date regulators, kept always in good repair, they can't possibly deliver the constant torch pressure you demand.

Going into the second sub-division: Jigs and their proper use, the aircraft industry has been the leader and maintained the lead in the use of jigs; they have given the subject no end of thought and serious consideration, because welding, if properly done, is the correct method of fabricating the steel aircraft structure. The aircraft industry, though in reality older than the welding industry, is still in its infancy and many people consider the airplane unsafe, but the aircraft industry demands, because of its own hope for development, that metal parts be fabricated safely and any real improvement in production method is adopted regardless of cost.

In the majority of aircraft factories, they have what is known as the production line or the bench line which employs anywhere from a few to many welders. Directly back of this line are stationed the bench mechanics, who fit and set up into the jigs the various parts used in the plane; these are usually termed "fittings." In most aircraft work, there is a right and a left hand fitting to every ship. Result, a right and left jig. As these fittings are put into these jigs, the bench men place them on the operator's table; the operator then tacks them in a designated number of places. This tacker is usually a welder who has possibly not had a great deal of aircraft experience and is not a master aircraft welder, for aircraft welding is an art in itself. Then the part is removed by the bench

*From a paper read before American Welding Society, Chicago Section, March 4, 1932.

†Barrett Hardware Co., Joliet, Ill.

mechanic and is passed down the line to the master aircraft welder, who completes the weld.

In the construction of the fuselage, two master aircraft welders work on each fuselage—one on each side. In the aircraft factories piece-rate was once adopted, but very soon abandoned, because it was found advisable to instruct the operators to take all the time necessary to make a weld, but to make it right. These welders are usually very closely watched by a welding foreman and his assistant, and sometimes one or more inspectors. It is not hard to tell if a man is soldiering on the job. The welder receives a respectable wage, depending upon his skill. In the smaller aircraft factories, where they employ one or two men as welders, these men of course are required to do all the work, but nevertheless the use of jigs is given proper consideration.

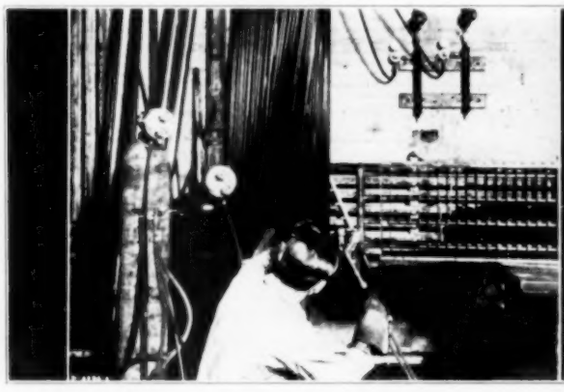


Figure 1. Proper Set-up of Equipment Reduces Rewelds to a Minimum in These Units Which Contain 10 to 50 Welds.

Figure 2. Total Production Time is 18 Seconds, Because Proper Tools are Provided and the Operator Sets Up His Own Work.

One of the most recent production operations that I have seen was in a stove factory. It was a brazing operation. The work was fast, the men had proper ventilation in the room with fans to blow the fumes away from them. The cost of equipment and rod was of very little consideration to the manufacturer. More and more industries are following that system which is worthy of consideration. Metal furniture builders are going to it.

By contrast, a plant in Ohio where the writer has worked a number of times was one of the places which had absolutely no conception of the use of jigs, the proper equipment, or consideration for the men themselves. The operators, when they needed a tank of gas, had to go and get it and roll it up to the work, which was usually a considerable distance from the welding room. This was an outrageous waste of time and money, because the plant had the proper equipment to deliver the tanks to the welding room. The work was all piece work and the rates were set by men in the Engineering Department who knew nothing of welding except it was a fabrication of metal—they had absolutely no knowledge of how long it would take a man to make a weld of a certain kind on a certain job.

At one time in that plant, I was working on a production job with three other men, and requested permission of the welding foreman, who happened to be a machinist, to bring into the factory my own light aircraft torch which was particularly adapted to the work we were doing at that time. It happened to be a government job. The other operators were using shop equipment and found difficulty in making $7 a day for 13½ hours work; I had no difficulty in making $11 and $12 a day with my torch. The government had an inspector on the job and I dare say 5% of the work the other men turned out were rejects; I had no rejects in those two weeks, and we turned out 10,000 pieces between the four of us. It is a matter of simple mathematics to figure the economy which would have been derived from the installation of proper equipment.

To tell how to construct jigs is rather difficult, but the basic principles are the same with slight variations. The jig should be designed for the work which is to be done—but be sure when you consider making jigs that you consider all angles. The little extra time spent in designing and engineering that jig correctly will more than pay for itself. If you are doing production welding, the most important thing to be taken into consideration is speed and assurance of good welds, providing of course you have good operators. The next thing to be considered, or possibly before the jig itself, is to be sure that the operator can work continually in a comfortable position—that he does not have to be cramped—that he has freedom of muscular control, for he is working always under physical tension.

The third sub-division is economy—profit—and the operator, or the "human element."

In today's highly competitive market one must produce good workmanship and a good product at a low cost. People are not looking for cheap merchandise; they want value for their money. One of the surest ways for any firm to profit is to deliver merchandise which will be re-ordered, because of its superior quality. This eliminates additional sales expense. To arrive at this end in production welding problems, you must provide the operator with the proper equipment—modern equipment. You must design and engineer your jigs correctly. You must see that the operator works in a healthy, normal, comfortable position. If you are insistent upon piece-rate work in your shop, you must set that rate so that the operator can earn a decent living wage; you must keep your operator happy, so that you can cut down labor turnover. You must make him feel that your shop is the best shop in the world to work in, that you are the best boss to work for, that he has the best equipment in the world to work with. Then, if you have good operators, you will get the maximum of results at the minimum of expense, because the primary requisite

of a good welder is honesty; no one knows better than the operator what kind of a weld it is; he sees the metal flow in, and he sees the results he is producing. There is no use trying to kid yourself with false economy by using obsolete or poorly designed equipment, cheap welding rod and things of that type. If you have not in your employ a competent man on whose judgment you can depend to assist you in those matters, you should employ one, because of the economy and the profit which will result. Should you not be able to employ such an individual on full time, there are men you can call in for expert technical advice, who will assist you in the correct selection of equipment, proper rods to be used, lick your welding problems by assisting you in developing correct jigs, helping you select competent welders and setting the rates that are fair to you and to your operator. To show a profit you must take advantage of everything that is offered to you that might increase your profits. Don't be satisfied with turning out inferior work; you will only lose out in the end.

The production jobs illustrated are practical examples of the points which have been made. Figure 1 shows the production welding of Shelby Tubing risers to Shelby Tubing headers on heat exchange coils of refrigerating units. These units are for use with sulphur-dioxide, methyl-chloride and also ammonia gas, and range in length up to 30 ft. long. It is therefore difficult to arrange the work for the convenience of the operator, necessitating as it does vertical, overhead and position welding. The finished unit is tested to pressures up to as high as 1,500 lbs. per sq. in. By providing the proper equipment for accurately controlling the pressures of these gases thereby assuring a neutral welding flame at all times, this company has been able to reduce leakage in the finished job to less than one leak for each thirteen completed units. There are anywhere from 10 to 50 welds per unit.

A production silver-soldering operation in the manufacture of high pressure brass fittings is illustrated in Figure 2. Unit production time, end operation to end operation is 18 seconds. The operator sets up his own work, (included in this time). These fittings are for using and controlling high pressure gases. They are tested to 2,300 lbs. per sq. in., immersed in water. By the use of high-speed mass production welding equipment, this manufacturer has been able to reduce his production costs to a negligible factor. Moreover, he has been able to increase the efficiency of the operator to the end that leakage has been reduced to less than one-tenth of 1 per cent.

Figure 3 illustrates the production manufacture of ducts for conveying high temperature air in industrial baking equipment. Notice that the manufacturer has neglected, in this instance, to employ jigs, thereby losing this help in the handling of these parts. The result is slower production rate and greatly increased loss of time for aligning the work preparatory to welding.

Production welding and brazing fin-coil air conditioning units is shown in Figure 4. Note that the work is very carefully aligned and jigged preparatory to welding. Also that it is placed in a position convenient to the operator, thereby greatly increasing his speed of production, and quality of workmanship.

Figure 5 shows the production brazing of the diaphragm plate and drive shaft for a benzine bellows of syphon-type heat regulating device. These small units are made of steel and are subject to a direct load of 250 pounds. On tensile test the drive shaft itself breaks with no distress to the brazed joint, at a direct load of 1,620 pounds or a yield of 54,950 pounds per square inch tensile strength. Production rate 300 per hour. This is a case of redesign engineering whereby the manufacturer, by accepting the recommendations of the welding equipment manufacturer eliminated five distinct operations in the manufacture of this unit. In previous mode of assembly it was necessary to notch the drive shaft, perforate the diaphragm, rivet the shaft into the diaphragm, maintain perfect alignment of the riveted parts before brazing and then to store lots of as high as 15,000 pieces before operating the brazing furnace. By proper redesign, by utilization of mass production welding equipment, and constructing jigs faithfully in accordance with the recommendations of his welding advisers, he released valuable floor space, improved the quality of his article, eliminated leakers, eliminated mis-aligned parts and made it possible to produce 50 units at as low a unit cost as that obtained in making 15,000 units. The helper loads and unloads the jig. The welder on the left does nothing but braze the part.

Figure 3. Production Rate is Slowed Down Because Jigs Are Not Provided to Hold the Work During Welding.

Figure 4. An Operation Similar to Figure 3. Quality and Speed Are Increased by Use of Jigs.

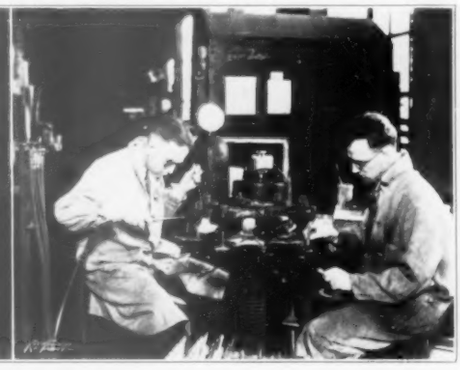


Figure 5. Redesign of the Product, Proper Equipment and Suitable Jigs Reduced Production Expense to a Minimum.

In all the foregoing examples gas economizers are employed to eliminate the wastage of valuable gases during non-productive time. Also, in all cases except one, the convenience of the operator has been respected. This feature returns dividends annually far in excess of the small cost required.

Papers Read at Buffalo to Be Both Practical and Technical

Technical programs of unusual quality will be sponsored by the seven societies and divisions cooperating in the Fourteenth Annual National Metal Congress and Exposition in Buffalo, the week of October 3rd.

The American Society for Steel Treating has announced that its sessions will contain a wide range of both practical and research papers. The program this year will be divided into sessions which will deal with the following topics: reports of metallurgical research; nitriding; drop forging; corrosion resistant steels; sheet steel; high speed steels; deep acid etching of steels; and heat treatment.

Technical programs for the National Metal Congress are also being arranged by the American Welding Society; Iron and Steel and Institute of Metals Divisions of the American Institute of Mining and Metallurgical Engineers; Iron and Steel Division of the American Society of Mechanical Engineers; Production Activity Division of the Society of Automotive Engineers; and the Wire Association.

Advance space reservations for the National Metal Exposition have more than exceeded expectations, W. H. Eisenman, secretary of the American Society for Steel Treating and director of the Exposition, has announced.

All-Welded Tanker Launched On East Coast

The all-welded steel tanker Lucy was launched recently at the yards of Brewer Drydock Company at Mariners Harbor, Staten Island. This new vessel was sponsored by Mrs. Lucy Reinauer, wife of the president of the Reinauer Transportation Company, of Kearney, N. J.

The Lucy will join the fleet of the Reinauer organization in about three months. She will be engaged in carrying gasoline from the refineries of Cartaret, N. J., to distributing stations on Long Island Sound. Every year each of these vessels travel over 30,000 miles which is equivalent to a trip around the world.

Two Westinghouse arc-welding sets were used in building this all-welded vessel, which is the largest welded tanker ever built in the port of New York, and is 147 ft. 6 in. long; has a beam of 26 ft. and a depth of 12 ft. Her keel was laid December 2nd, of last year. She has a capacity of 230,000 gallons and was built by the R. F. Smith Lock-Notch Welded system of construction. She will be propelled by a 400 H. P. Ingersoll-Rand Diesel engine.

Where to Look for Welding Jobs in the Rural Community

In the days not so long past the farmer's main metal problem was keeping the shoes tight on his horses and the tires snug on his wagons. Mechanization has changed this picture much as it has changed activities in other industries. At the same time the activities of the rural blacksmith shop have changed accordingly. With very few horses left on the farms, the village smith has of necessity changed the service that he renders his community. Where once he heated and shaped horse shoes and wagon tires in the forge he now uses the welding processes to work metals mainly in repairs to the farmer's metal equipment.

Blacksmith shops of a few years ago were called on to render a few types of service and when any of these were needed the work was taken to the one closest at hand. It was only necessary for the smith to locate his shop where there was a large number of possible customers and a minimum of competition. There was little selling to be done. With the welding process at hand, however, there are many more services that can be rendered to a farming territory, but each of them has to be talked up to acquaint each and every prospect with what he can buy. It is strictly a selling proposition, but it is a simple one, once the seller knows what he has to offer and how to make the offer.

The table below which was prepared by Lee Everson, Welding Engineer, for W. J. Holliday Co., Indianapolis, Ind., gives the amount of business that the welding shop should do in an average rural district per hundred customers counting 32 per cent labor, 48 per cent overhead and 20 per cent profit:

There should be	He should		Total
100 plows	repoint 75 shares @	$1.50	$112.50
	hardface 100 shares @	4.00	400.00
125 cultivators	apply Stoody Self-hardening metal to 500 shovels @	.50	250.00
75 mowers	weld 75 cutter bars @	.75	56.25
	weld 25 frames @	2.50	62.50
	weld 10 wheels	2.00	20.00
100 corn planters	weld new shoes on 50 prs. runners @	5.00	250.00
	25 wheels @	1.50	37.50
100 grain drills	apply Stoody Self-hardening metal to 500 shovels @	.50	250.00
50 binders	weld 40 cutters bars @	.75	30.00
	weld 35 cast iron gears @	1.00	35.00
50 corn pickers	hardface conveyor links, 200, @	.30	60.00
75 gasoline engines	weld 25 frozen heads @	1.50	37.50
25 hay balers	15 feeder arms, welded @	3.00	45.00
150 farm wagons	weld 200 iron wheels, average @	2.75	550.00
25 threshing mach.	Stoodite 200 separator teeth @	.40	80.00
25 corn shellers	building up burrs on 15 cones @	4.00	60.00
75 wind mills	weld 25 pump handles @	.75	18.75
	weld 35 sucker rods @	.50	17.50
100 disc harrows	applying Stoodite to 200 disks @	1.00	200.00
100 tank heaters	weld 25 cast iron @	2.00	50.00
	should make up and weld "Himself" 10 @	5.00	50.00
100 automatic waterers	should make up out of old "oil drums" and sell 25 @	6.50	162.50
25 farm gates	should weld up out of old pipes 25 farm gates @	10.00	250.00
65 tractors	welding in cost of maintenance per year	150.00	150.00
50 trailers	welding in cost of maintenance	500.00	500.00
	weld 10 frames @	10.00	100.00
500 miscellaneous welding jobs		@ 1.00	500.00
		Total	$4335.00

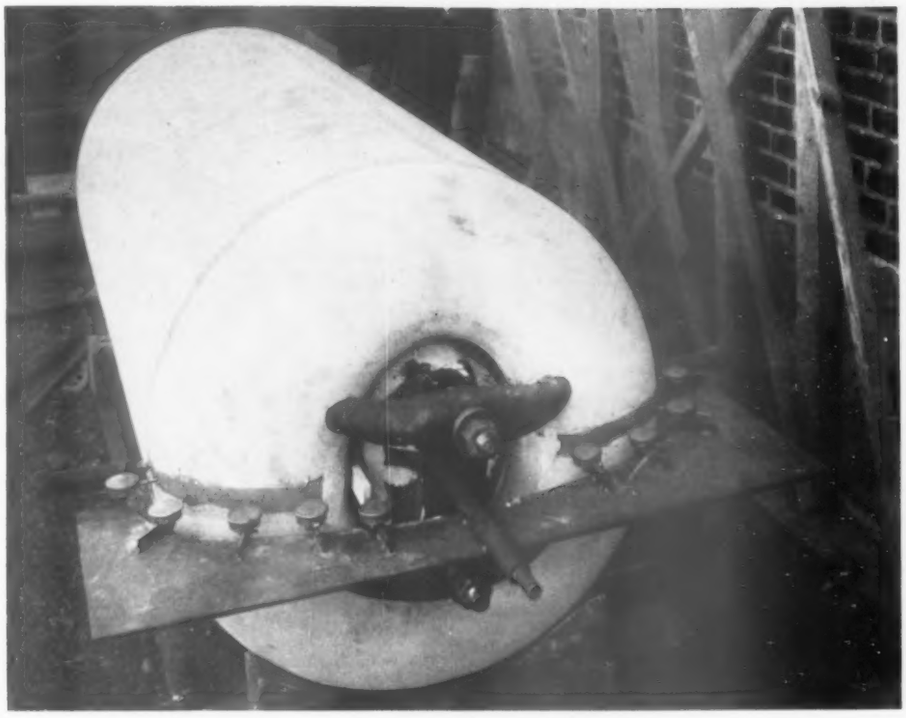


Figure 1. Drum Set Up for Testing. Highly Stressed Areas Are Detected by Local Scaling of the Whitewash.

Developments in Fusion Welding

By T. S. Murphy, Jr.†

When better pressure vessels were demanded, welding engineers showed how to make them. The pioneers in this part of the industry were years ahead of the codes. This article tells how processes were improved and by what searching tests the dependability of new methods of construction was thoroughly demonstrated.

THE successes realized by manufacturers of welded pressure vessels have made evident the improvement that can be made in many applications of welding, and have furnished many basic ideas toward such improvements.

The disadvantages of riveted construction in various types of vessels gave rise to the attempt at developing a weld capable of being substituted for riveting without carrying its disadvantages.

The increasing demand for steam power plants with higher efficiencies and greater capacities has necessitated plate thicknesses for boiler drums beyond the practical limits of riveted construction.

Refining practice requires heavy vessels to withstand high pressures and temperatures. Many of these must be of smooth bore to facilitate the installation or removal of internal filter trays, etc. Welded seams are well adapted to these needs. When riveted construction is employed in such vessels, inside rivet heads must be countersunk and inside butt straps eliminated, with a resulting sacrifice of efficiency.

Of late, certain by-product gases obtained in oil cracking have come into valuable use as fuel. A representative example is butane; the vapor pressure of the gas being over 100 pounds per square inch, its practical storage necessitates large tanks of strong design, with a minimum of material for obtaining the desired strength.

In their efforts to improve welding to a point where its quality would permit its application to pressure vessels, the various pioneering organizations faced the task with their own resources.

To relate the progress that has been made, a summary of earlier discoveries followed by major recent practices, requirements, tests, and equipment essential to code welding, should be reviewed.

The Hedges-Walsh-Weidner Company has been one of these pioneering organizations. The material for this

†*The Hedges-Walsh-Weidner Co., Chattanooga, Tenn.*

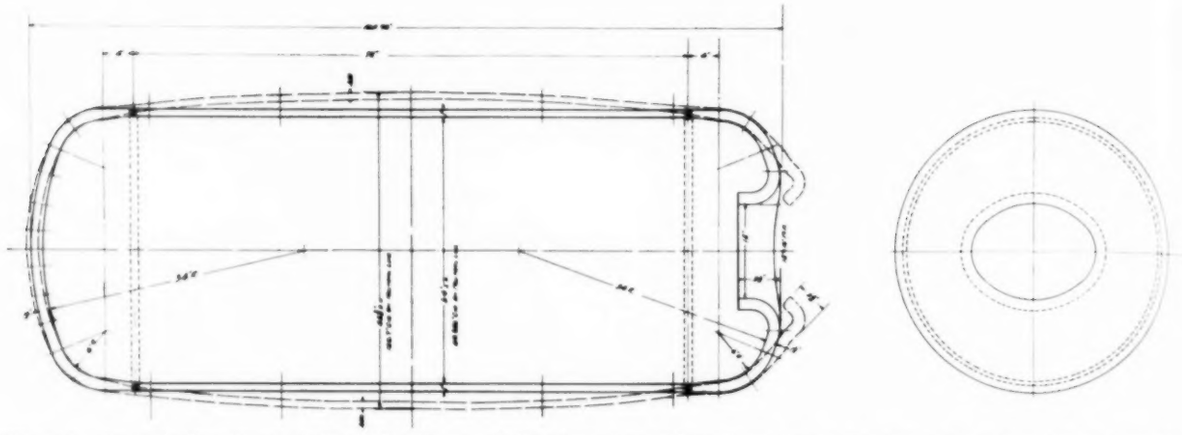


Figure 2. Cross Section Through the Boiler Drum. Solid Lines Show Dimensions Before Testing. The Distortion of Testing is Shown by Dotted Lines.

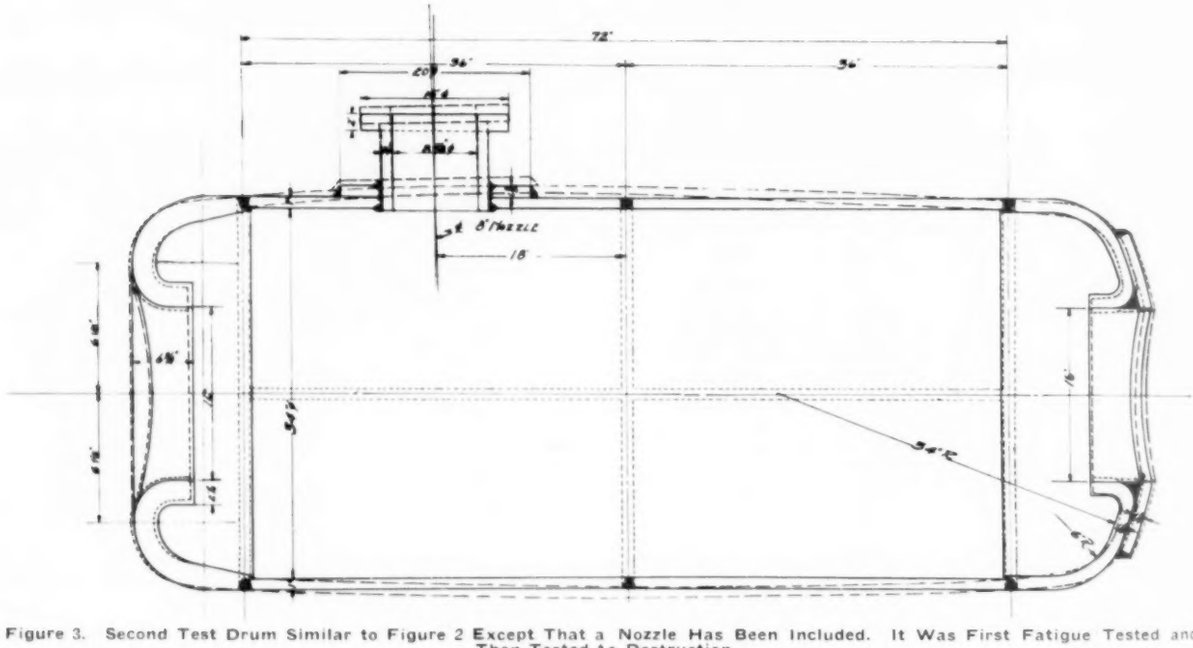


Figure 3. Second Test Drum Similar to Figure 2 Except That a Nozzle Has Been Included. It Was First Fatigue Tested and Then Tested to Destruction.

article is taken chiefly from that company's experiences with fusion welding.

At the beginning it was realized that no existing method of welding in its state of perfection at that time was sufficient. The quality of the proposed welding was regarded as being of prime importance. From a practical standpoint there was necessary a combination of quality with economical methods and equipment for the work.

The weld to be obtained must have uniformity of character throughout its length and depth. The ideal to be sought after would be a weld having the same physical, chemical and metallographic properties as the parent metal. Of acetylene, carbon arc and metallic are welding the latter was chosen as the method holding particularly favorable possibilities.

As an improvement over bare rod welding there were several brands of flux coated rods on the market. Many of these had been used in the plant, with better results than with bare rods, but their performance was at the same time considerably below that which was necessary. The first major task was the development of a suitable coating for the rod.

All the functions of this flux coating are still a matter of discussion, but apparently its accomplishments are three-fold:

It must be a material having the same rate of fusing as the electrode so that protection is afforded just previous to, and at the point of the electrode which is being converted into the vaporous state at the arc. It probably provides to some extent a cylinder of shielding vapor to the metallic arc, preventing combination with atmospheric gases which burn out the carbon content, oxidize the vapor, and allow the harmful formation of nitrides.

Second, as the flux is deposited on the surface of the molten metal it forms a protective coating during the solidifying and cooling of the metal.

Third, some of the molten flux is carried beneath the surface of the metal pool at the base of the arc by the disturbance resulting from the velocity of the vapor stream, and there tends to unite with impurities in the deposited metal and float them to the surface as slag.

As soon as a satisfactory compound for coating material had been obtained, extensive series of experimental welds were begun. They included conditions which would influence the speed and quality of the work.

Since the behavior of welds in flat plates, when sub-

jected to physical tests, is not likely to be the same as for the same welds in a cylindrical vessel, it was desired to put them to an entirely reliable and practical test, by testing to destruction welded vessels, in the construction of which the new weld would replace the time-honored rivet. Before testing, the vessels were to be stress-relieved at about 1200 degrees F.

Some experimenters with this type of welding have advanced the theory that this annealing of the weld is unnecessary, as the heat from each successive bead laid stress-relieves the preceding one. This seems feasible enough, but the proponents of the belief have probably never analyzed the behavior of two flat plates when butted together and welded from one side. If these plates are laid flat and not clamped down, then as the successive beads of metal are deposited the whole will gradually buckle. This buckling accompanies the contracting of the cooling metal. Should the metal be secured against any natural contracting, the tendency toward such action would cause internal stresses. Their magnitude is often sufficient to cause internal cracking of the metal. These same conditions are encountered in welding a cylindrical vessel, where the rigidity of the shell prevents to a certain extent any stress adjusting movement.

The test drum as ready for testing is shown in Figure 1. Highly stressed areas were detected by the local scaling of the whitewash with which the drum was covered. The material used in the shell and heads was ordinary boiler plate, firebox quality, of one inch thickness, 55,000 pounds per square inch minimum tensile strength. The solid lines in Figure 2 show all dimensions before testing. In fabricating, three seams were used, one circumferential welded seam joining each head to the shell and one longitudinal seam, all three seams being butt welded. With the exception of one inner bead, all metal was deposited from the outside. The seams were first tack welded and then completed. The welding groove resembling a "V" extended from the outside surfaces to within one-eighth of an inch of the inner surfaces. The remaining eighth-inch thick tongues at the bottom of the grooves when butted together formed a trough for the deposited metal. As the first bead was laid these abutting tongues were fused to a goodly depth, but naturally their bottom portions remained unfused, though tightly butted together by the contractive stressses in the weld metal. Therefore, after the groove had been welded up, a cut was taken out of the length of the seam from the bottom, the depth of the cut being sufficient to remove all unfused metal and at the same time provide a groove for the backing bead.

A. S. M. E. specifications allowed 80 per cent for the seams. The working pressure was 517 lbs./sq. in., and for the one and one-half inch blank and manhole beads, 583 and 506 lbs./sq. in., respectively.

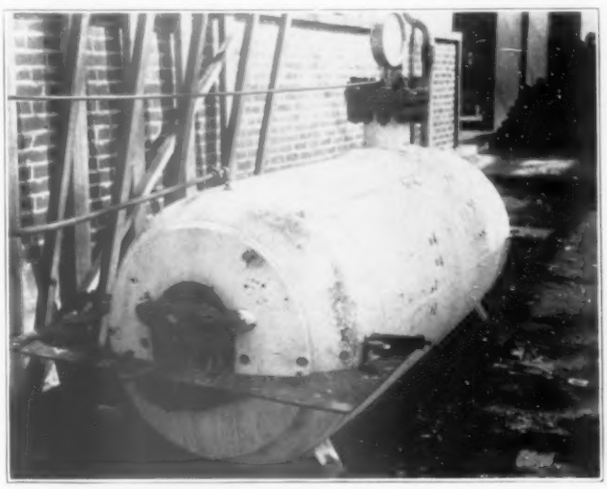


Figure 4. Vessel (Figure 3) Undergoing Fatigue Test of 10,000 Cycles of Pressure.

This test consisted in subjecting the vessel to increasing hydrostatic pressures from zero to failure, between each increase the pressure being removed. The testing was carried to 3250 lbs./sq. in., at which point the manhole had almost become inverted, thus destroying the gasket seating and preventing the test from being carried further. At the conclusion of this test the drum had taken on the appearance of a steel barrel. The manhole head, in its tendency to become inverted, increased the length of the drum four and one-half inches, and the circumference had increased 13.688 inches, or 11.1 per cent. The final dimensions are shown in dotted lines in Figure 2. All welding remained sound throughout the test.

A second test drum was built in order to study more completely the adequacy of welded construction. Other pertinent features previously discussed were included in

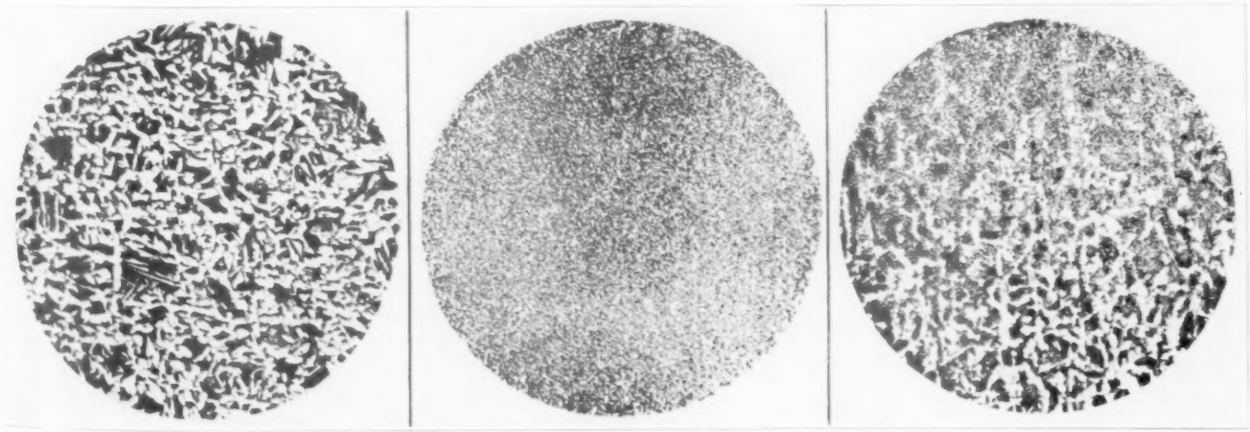


Figure 5. Photo-Micrographs of Metal Taken from Number 2 Drum.

Parent Metal Adjacent to the Weld. Etched. X250. Unaffected by Welding Operation.

Weld Metal. Etched. X250. Shows Fine, Dense Grain Structure Throughout.

Junction of Parent Metal and Weld Metal. Etched. X250. Indicates Complete Fusion.

the design. The most important of these were the welded reinforcing of manhole and nozzles, and the determination of the ability of the welds to withstand fatigue tests. The shell of this drum was made to have a center girth seam. This second drum is shown in Figure 3. As before, the shell was designed for 517 lbs./sq. in. working pressure. The standard A. S. M. E. Code manhead was designed for 700 lbs./sq. in., while the special manhead and nozzle with welded reinforcing were for 650 lbs./sq. in. After being stress-relieved in the same manner as drum No. 1, this drum was subjected to a fatigue test of 10,000 cycles from zero to one and one-half times working pressure, for which treatment it appeared none the worse. The destructive test was imposed next, being witnessed by the members of the "National Board of Pressure Vessel Inspectors," then convening in Chattanooga. The testing was carried to 3450 lbs./sq. in. with little perceptible distorting of the drum. Gasket and pipe connection leaks prevented the test being completed.

For the heads, the reinforced one with its design for 650 lbs. was apparently stronger than the regulation head for 760 lbs., since considerable flaking of the limewash began around 2000 lbs. on the latter, while flaking on the reinforced head slowly began around 2250 lbs.

Desiring still further to investigate the vessel's members, another fatigue test of 10,000 cycles of pressure application was imposed. The vessel remained sound (Figure 4).

An insight into the excellent performance of the welded joints in these tests is to be had in the photo-micrographic study of the welding and the area in the plate adjacent to it. Note from this study in Figure 5 that the parent metal adjacent to the weld is unaffected by the welding operation, while the juncture of the two sets forth the complete fusion obtained as the parent plate gradually and uniformly merges into the fine dense grain structure of the deposited metal.

These tests climaxed the series of preliminary investigations and experiments conducted while the present and considerably more rigid Code was nothing more than tentative proposals.

Possibly the greatest expansions and improvements have been ushered in since the advent of the standard Code. Many of them now constitute a sizeable portion of the regular program for the building of welded vessels, the X-ray examination and stress-relieving operation being of major importance.

(To be continued)

Ideal Details for Electric Welded Steel Structures*

By Paul B. Covey†

Once more we imagine ourselves in this building of magic—the building whose framework of steel seems to just grow—without any apparent effort, because such care had been taken in the preparation of simple, yet highly effective details. Let's look around and see what we can find.

First, there are the usual heavy bed plates grouted to the concrete footings and ready to receive the steel columns. There are no anchor bolts apparent, but they *are* there, nevertheless, welded to the bottom of the plates, and are very securely holding the plates in their true and final position.

Then we notice that the columns have plates welded to their lower ends—but no holes. Of course not, holes are expensive to drill in such heavy plates—also "holes" require matching with other holes, and this means time and time means money. There is no need for these holes anyway, for these plates are to be welded completely to the bed plates we have just been looking at.

Next we run across a queer method of splicing column sections together—very simple and yet extremely rigid and effective. There are the usual side plates, but contraptions have been welded to the main shafts to guide the plates into position and hold the columns rigidly in place.

Then there are odd looking pieces welded securely to the flanges of the columns, and inside the webs in some cases. They are guides to direct the ends of the beams into place, to plumb them accurately and to hold them securely in position until the welder comes along and puts on the finished welds. What a time-saver and cost-saver too!

There are hardly any details visible at all and yet there seems to be ample provision for properly and securely setting all steel members in place. Surely only through the use of welding could such simple details be sufficient.

Next we find light weight open-frame floor trusses or joists—they are all welded. They are just miniature trusses—vest-pocket editions, as it were—light, simple and effective. Ample space is left for pipes, conduits, sound proofing material and so forth, and how easily they are fastened to the main steel beams. All that is required is a little welding at each joint.

Then there are queer built-up lintels—no gas pipe separators or cast iron separators with ugly bolt heads in the way or bolts to work loose. They are spaced and stiffened by tie plates securely welded on the inside between the various parts of the sections; simple and rigid.

Now come the plate girders, with no angles at all; only bars and plates—plate chords, plate webs, bar stiffeners, plate splicers and bearing plates. That's all except, of course, the welds themselves.

Then we come to the trusses with such small tension members and no gussets at all, no connection angles, no holes—in fact, nothing that has always, in the past, stood for "good truss design." Yet how much simpler these are and how much more rigid and effective and, in reality, how much neater in appearance.

Looking over all these simple details at every point and realizing the tremendous saving in weight, floor after floor, it seems as if there must be a great economy in the design of the foundations. Yes, it is quite apparent—look at those footings and compare them with the sizes usually found in buildings as large as this. What a difference—so much less concrete required—quite an item of expense saved right there.

We have noticed one thing especially in looking over these details. It is this—how small the welds seem to be—and how neat. Why it seems as if every weld was put there for a specific purpose—not just "so as to be sure to

*Third in a series on "The Ideal Application."
†Consulting Welding Engineer, Manchester, N. H.

have enough." The welds are all so carefully and accurately spaced and so neatly deposited. There must be a wonderfully equipped and carefully trained crew in the shop from which this welded material has come. Some one must have been responsible for such neat and accurate work—and this "someone" must have very thoughtfully organized and trained the welders who worked on this job.

Next month we will take a run over to the shop from which this welded material came and make a careful study of this phase of the "ideal application."

Welding Research Permits New Uses

WELDING of high-speed rotating machinery, high-pressure boilers and similar equipment has been made practical and safe by recent research discoveries and the new process will save hundreds of thousands of dollars in the cost of manufacturing such apparatus.

These statements were made by Franz R. Hensel and Earl I. Larsen, research engineers, of the Westinghouse Electric & Manufacturing Company, who have made a study of the transformation points of fusion weld metal.

Knowing that welded joints would withstand higher stresses and more severe impacts if they were more ductile, the two engineers obtained this greater safety and dependability by intensive research into the metallurgy of weld metal. Increase in ductility was the result.

Pure iron used as welding rod is very ductile before the welding process. Formerly, this ductility occasionally disappeared in the welding process, leaving a brittle weld.

Controversy was waged by engineers over the cause of this brittleness. Some attributed it to oxygen from the air which combined with the weld metal during the welding process. Others, including Westinghouse engineers, blamed it upon nitrogen from the same source.

Hensel and Larsen proved conclusively by their metallurgical probings that nitrogen was the culprit in this technical crime. They were able to show that not only the quantity of nitrogen which combined with the iron, but also its physical form had important bearing on the weld ductility.

They also discovered that nitrogen increased the rate of expansion and contraction of weld metal at high temperatures. This caused warping and possible failure of the weld.

A method of controlling the errant nitrogen was sought. They succeeded by cooling the hot weld slowly which left the nitrogen relatively harmless.

While working on this problem, the two engineers determined for the first time, the transformation points of weld metal throughout its temperature range. At these points, the atoms and molecules of a metal rearrange their physical structure.

Having traced the blame to nitrogen, Hensel and Larsen delved into deeper metallurgy to learn how it affected weld ductility. They found that when a ductile metal is bent or stretched, layers of the metal slide past each other along "slip planes" just as the leaves of an automobile spring slide along each other when the wheel strikes a bump. A brittle metal will not bend or stretch, but snaps without warning when loaded to the limit of its strength.

If welds cool too fast, iron nitrides are held in solution as the weld metal hardens. When ordinary temperatures have been reached, the iron nitrides are slowly precipitated out of solution, become as foreign particles in the weld metal. Although too small to be seen even with a microscope, they were found to lodge in the "slip planes," preventing the layers of metal from sliding past each other. Sand between the leaves of an auto spring would have a similar effect.

Just as a sanded auto spring would snap under a severe jolt, a weld of high iron nitride content will fracture under severe stress. In this respect its behavior is more like that of cast iron than that of either iron or steel.

Slow cooling forms iron-nitrogen constituents in the weld metal, which, although larger in size than the iron nitrides precipitated after fast cooling, have less harmful effect on the ductility of a weld.

Much of this trouble can be avoided by preventing the nitrogen of the air from combining with the weld metal during the welding process. Chemical coatings for the weld metal have been developed. So effective are they that only minute, harmless quantities of nitrogen are able to enter.

New, important fields in the fabrication of machinery are opened to welding by these discoveries. Now that the ductility of weld metal is assured, welds can be exposed to higher stresses and to more severe and more frequent impacts than ever before.

Electric welding can now be entrusted the task of knitting together the parts of armatures, spindles, flywheels and the like which are subject to high centrifugal forces while rotating at hundreds of revolutions per minute. It can also be employed to maintain the lowest vacuum or to withstand tremendous pressure, in sealing the seams of immense condensers or of giant boilers.

Compared with other conventional methods of fabricating machinery, the welding process has advantages of greater speed and lower cost, according to Westinghouse engineers. They estimate the savings it will effect will be equivalent to hundreds of thousands of dollars annually to American industry.

A Welded 82,000 Pound Frame.

One part of one product—a generator frame—recently completed at the Westinghouse East Pittsburgh Works—contains eighty-two thousand pounds of steel, entirely fabricated by the electric welding arc. This frame, constructed in three sections, is 25 feet in diameter, 67 inches high and is a part of a 66,700 Kv-a. waterwheel generator.

Figure 1. Farm Water Supply Tanks of 10-Gauge Copper Bearing Steel.

How a Small Shop Can Build Business

Welded products which fill a real need, and are built to meet an unconditional guarantee find a ready market anywhere. The small shop, with its low overhead, can make attractive prices and show a good profit. This article tells how one welder does it. The products of his shop fill a sixteen page catalog.

AT first thought it would appear that a welding shop located in an agricultural community would have comparatively little opportunity to build up a consistently thriving business, that it would be necessary for such a shop to wait for agricultural implements and automobiles to come into the shop for repair. Therefore, a good many shop owners in farming communities think that they have much less opportunity to keep supplied with a good volume of work than those shops which are more fortunately located in the large, industrial centers where there is much heavy repair work constantly coming in.

This is not the case with Peter Frederiksen who has a splendid, large, brick building for his welding and repair shop in Audubon, Iowa, and keeps himself and two others busy a good portion of the time. Mr. Frederiksen does this because he has designed and sold a number of very useful and necessary articles for farmers. He advertises these as "Pete's Products" and emphasizes the fact that they are built to last a life time. This manufacturing business has been so successful that he has printed a 16-page catalog, as well as several illustrated circulars, giving pictures and prices of all those articles which are not made to order. The accompanying illustrations are reproduced from the catalog and show some of the popular items in the fabrication of which welding is an important factor.

Figure 2. Welded Tank Heater. It Burns Old Crank Case Oil, Cobs, Wood, Etc.

The farm water-supply tanks, shown in Fig. 1, are made of 12 gauge copper-steel shells with 10-gauge copper steel bottoms. The upright seams are riveted, then welded inside and out and a heavy band is welded on the top for reinforcing. Standard construction includes overflow construction welded in at the top, a one-inch pipe connection welded in the bottom for a supply pipe and a two-inch connection at the bottom for cleaning purposes.

Another welded steel product is the tank heater shown in Fig. 2. This heater will burn old crank case oil, cobs or wood. It heats the tank quickly and the adjustable draft controls the fire completely, making it possible to meet weather conditions as they come. These heaters have been sold in Illinois, South Dakota, Kansas, Nebraska and Iowa.

One of the simplest products of this shop is the barrel-type hog waterer, shown in Fig. 3. After a glance at the illustration, the reader will assume that this is made from an old oil drum, and this assumption is exactly correct. There is scarcely any more involved in the construction than simply cutting out a section to let water into the trough, fabricating the trough out of sheet metal and welding it to the edge of the barrel. The skids which are welded on make it easier to move the water when it is filled. The device is just as simple in operation as it is in construction. There are no valves. The user simply fills it up, screws in the plug at the top to make it air tight and it is ready to work. It can be set outside the pen or shed with the trough inside and covered over in winter to keep it from freezing. In this case it can be filled through a pipe in the top. These are advertised

Fig. 3. Barrel Type Hog-Waterer. It is Easily Made from Old Oil Drums.

at $5.00 each and if the customer wishes to furnish his own barrel the price of fabricating is set at $3.00 with 50c each for welding on extra connections. Hundreds of these waterers are in use and it is a very popular item.

A more elaborate product is the all-steel automatic waterer shown in Fig. 4. The all-steel construction renders it fire-proof and it is equipped with a burner which will operate for more than 24 hours with 1 gallon of gasoline. The trough part of the waterer is 4 ft. long, 2 ft. wide and 14 in. deep, making it easy to remove water with a bucket. The tank holds 50 gallons and is always full as long as there is water in the supply tank.

A pile of welded copper-steel hog troughs is shown in Fig. 5. These are made of 12 gauge Keystone copper-steel. Mr. Frederiksen says that they have laid one of these troughs on the pavement of the sidewalk and have driven a McCormick-Deering tractor over it without damaging the trough. As can be seen from the illustration, these can be made in any length from 2 ft. up.

Another interesting line is the line of steel double trees and neck yokes illustrated in Fig. 6. It is pointed out in the catalog that there is nothing to come loose on these parts because every part is securely welded. Standard pipe is used in the making of eveners and neck yokes. They are all-welded with a welded-in truss. A steel bushing is welded in every place where a hole is drilled in the pipe. Common machine bolts are used, so that the bolt, instead of the bushing, will take the wear. The worn places can be replaced with small cost, making the life of one double tree almost indefinite. These are sold under a guarantee against breaking or bending.

These illustrations show just a few out of a number of useful farm articles fabricated in the shop. There are three outstanding features in the design of all of them.

1. Each one of these products has been designed as a result of studying the needs of the farmer and has been constructed to give the farmer something which will have long life and do the job required. 2. The design and construction is in all cases very simple. 3. Good serviceable materials are selected with proper thickness to insure long life and welding is used to make permanent leak-proof joints.

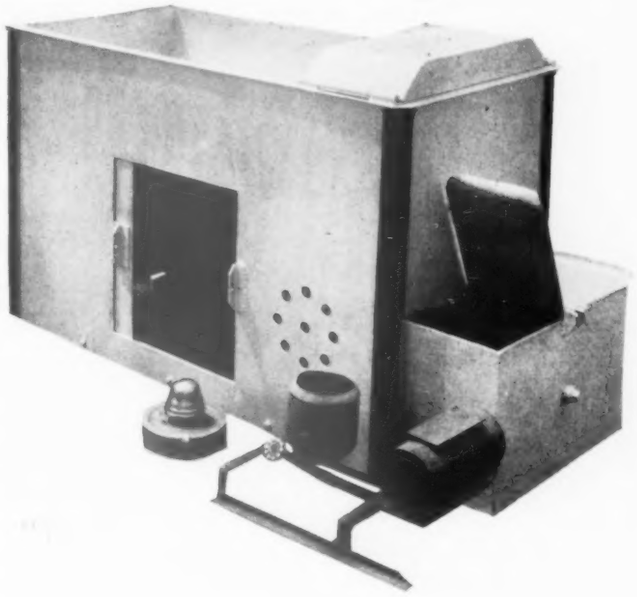


Fig. 4. Fifty-Gallon All-Steel Automatic Waterer is a Profitable Item.

Fig. 6. (Above.) A Complete Line of Double Trees and Neck Yokes. They Will Not Come Loose, Because They Are Welded.

Fig. 5. (Left) Twelve-Gauge Keystone Copper Steel Hog Troughs. Running a Tractor Over Them Causes No Damage.

This shop has been doing oxy-acetylene welding since 1914 and electric welding since 1928. It fabricates wagon tanks, fuel oil tanks, play ground equipment, flag poles, chimney extensions and smoke stacks. It also handles a complete range of repair work on automobiles, farm equipment, etc.

In the course of correspondence with reference to this profit making line of welded products, Mr. Frederiksen has indicated that there are no secrets of design and construction and that he is glad to have other shops get the benefit of the ideas which he has used in building his business. However, it is practically out of the question for him to answer inquiries for information regarding details as he does not have facilities for doing so. The suggestion is that any shop owner desiring to manufacture any of these products should purchase one from him at the catalog price and use a completed sample for obtaining all detailed information and in this way save a good deal of the work and cost of experimentation.

As a matter of fact the formula used in this shop for maintaining production is one which might well be followed in a lot of larger institutions equipped with metal fabricating machinery. First find out what the public needs; then find out how to make it right; and then tell the public about it.

Session on Ductility a Feature of A.W.S. Annual Program

An outstanding feature of the program of the Annual Meeting of the American Welding Society, which was held April 27th to 29th, at New York City, was the symposium on ductility in welds. Altogether there were nine papers presented showing the results of as many different investigations of the subject of ductility. These different papers are all printed in the April and May issues of the *Journal of the American Welding Society*, and altogether represent a splendid contribution toward progress in the scientific application of the welding processes.

At the meeting of the Board of Directors, which was held Wednesday evening, April 27th, the presidency of the American Welding Society passed from Mr. E. A. Doyle to Prof. Frank P. McKibben. For a number of years Prof. McKibben has been one of the leading American authorities on the subject of arc welding structural steel. He has supervised the erection of some of the largest welded steel structures in the country and has written many articles descriptive of this work in addition to talking before over a hundred different groups. Prof. McKibben's work in the American Welding Society has been active and continuous for a number of years. He has been a member of the Board of Directors, of the Executive Committee, and Vice President of the Society, and has served on such important committees as the Structural Steel Welding Committee, the Committee on Building Codes, and others. He was born at Fort Smith, Ark., November 13, 1871. He is a graduate of the Massachusetts Institute of Technology, of the class of 1894. Since that time he has had a successful career of teaching, writing, and consulting work in the engineering field. Prof. McKibben is known throughout the welding industry for his unusual ability and his fine personality and is assured of the whole-hearted support of every member of the American Welding Society.

Welding and Cutting in Scrapping and Scrap Yards

The wrecking, scrapping and demolition of obsolete equipment has been of special interest during the past year. Many industries have provided employment for their workers by scrapping worn out or obsolete machinery, railroad cars, locomotives, ships and other pieces of equipment no longer of service.

The scrapping of ships, cars, locomotives, gas works, industrial plants, etc., is generally done by a scrap dealer who contracts to demolish and remove the material. The scrapped material is usually disposed of to the foundries and steel mills to be remelted. The railroads in most cases have preferred to do their own scrapping, using their own men, but in some instances the work has been contracted to outside dealers.

The oxy-acetylene cutting torch plays a very important part in scrapping operations and special attention has been given in the past year to its economical operation. Scrap prices have declined, but the better labor supply available, together with more attention by the management to the scrapping operations has helped to reduce the decline of profit margin.

The installation of acetylene generators and oxygen mainfolds with pipe line distribution systems has reduced the cost of gases by eliminating time lost in cylinder changing and handling and provided an effective control of gas pressures. A definite plan for the demolition work, for example on freight cars, has resulted in appreciable savings. A procedure was outlined whereby at certain points in the line, particular operations were to be performed on certain members. The tip sizes, gas pressures and the order in which the cuts were to be made were specified. On one car scrapping operation where the work was properly controlled and supervised, the cost of cutting per square inch was reduced 50 per cent below what they had formerly considered to be good practice.

The former practice had been to allow the operator to select his own tip size, pressures and speeds, but this has been shown to be expensive. The average operator unfortunately does not always use the correct pressures and tip sizes either because he does not know better or because he is not inclined to change them. A study of the situation by the apparatus manufacturers has shown that satisfactory cuts can be made at reduced oxygen pressures and consumption, without sacrificing speed, especially in scrapping work where quality of the cut is not important. Excessive preheating orifices and pressures for the work at hand have been eliminated with a further reduction in costs.

The type of rivet cutting tip now on the market which permits very rapid destruction of the rivet head will frequently eliminate many linear inches of difficult cutting, especially where more than one layer of metal has to be penetrated.

The piece-work plan, with the rates adjusted so that each operator is charged for his own oxygen and acetylene, is advantageous for scrapping operations as the operator is not interested only in saving time, but gases as well, and he will change his tips and pressures when necessary.

*From the 1931 *Report of the Oxy-Acetylene Committee* of the International Acetylene Association.

They Could Not Be Safer

In striking contrast to the old idea that resistance welds were not uniform enough to be reliable are many modern applications of this process where we trust our lives to small welds—with a high factor of safety. Tips and dies that hold contact areas constant, plus automatic control, achieve this dependability with a lower operating cost.

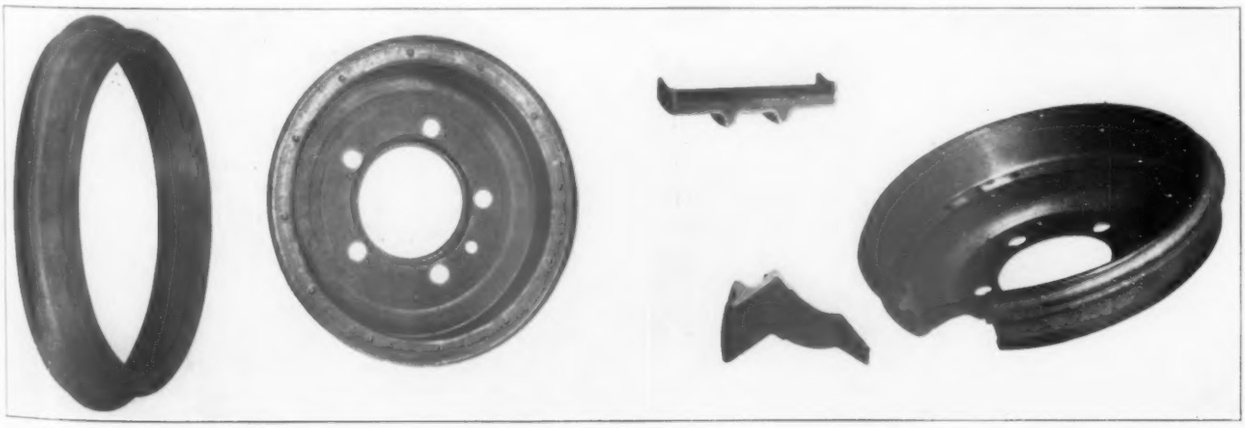
WHEN metal products are assembled by the resistance welding processes, using the modern machines and materials available and following up-to-date practice, those articles are just as safe as it is humanly possible to make them. This is the conclusion derived from a talk given before the American Welding Society, Chicago Section, at its regular monthly meeting May 6th, by G. N. Sieger, Metallurgical Director, P. R. Mallory Co., Indianapolis, Ind. The title of the lecture was "Welding and Cutting with Elkonite and Carboloy," Elkonite having a definite place in the resistance welding field and Carboloy in the manufacture of metal cutting tools.

In the introductory portion of his talk, Mr. Sieger spoke of the earliest applications of spot welding, most of which were articles of ordinary hardware not requiring great strength at the joint. Whatever disappointments there were in the early uses of this process occurred in cases where it was desired to have the welded joint develop the full strength of the material. It was found possible to make thoroughly satisfactory spot welds on an experimental basis, but when the work was put into production, a considerable lack of uniformity was encountered. This lack of uniformity is easily accounted for because the copper electrode tips used in the early days would become heated and squeezed out at the point so that the area of contact was continuously enlarged. This obviously changed the heating rate and the only way to correct the condition was to dress the electrode points frequently. The substitution of a tip material which retained its hardness at high temperatures and thus prevented mushrooming was a logical solution. Elkonite, an alloy of copper and tungsten, with a compressive strength of 280,000 pounds, as against 80,000 pounds for hard drawn copper, has been successfully used as a tip material. Several years of research experiments have resulted in the perfection of tip shapes and water cooling devices so that this material can now be said to be working at maximum efficiency in many plants.

The use of electrode tips which retain their shape and proper water cooling devices has raised the standards of spot welding to the point where uniformity is taken as a matter of course. This means that when the current, pressure and timing have once been properly adjusted to produce a perfect weld, this adjustment will be maintained throughout any number of cycles of operation and will produce identical results at each spot because there is no variation in the contact area.

Results like this have led to the use of resistance welding in the production of a great many parts to which the safety of human life is entrusted on a very large scale.

A further refinement in the spot welding process is the rapid development of projection welding during recent years. This process has the double advantage of making a large number of spots at one operation and of concentrating the welding heat at the point of contact of the two surfaces to be joined so that the fused metal is

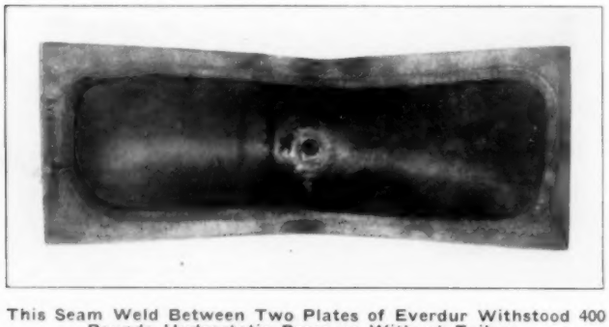


Units of a "Centrifuse" Brake Drum. The Pressed Steel Shape on the Right is Welded to That on the Left. Note the Projections for Making the Weld.

Cut Away Sections of a Completed Drum Showing Its Construction. Upper Left is a Duplex Ring Before It is Cut Apart.

pressed or forged together. As an illustration of an application where safety is of paramount importance, there was cited the "Centrifuse" brake drum manufactured by the Motor Wheel Corporation of Lansing, Mich. This type of brake drum which is used in a number of popular makes of cars, is said to have a safety factor of five, and the manufacturing process is a very interesting one.

It is pointed out that the matter of safe, dependable brakes is becoming increasingly important. Automobile engines are developing greater speeds, the cars themselves are heavier, and the increase in use of free wheeling is



This Seam Weld Between Two Plates of Everdur Withstood 400 Pounds Hydrostatic Pressure Without Failure.

putting as much as 40 to 50 per cent extra work on the brakes. The highways are becoming more crowded, speeds that were rare and reckless a few years ago are now commonplace and legal, and authorities in safety work have estimated that over half of the accidents are chargeable to brakes that failed to work. Certainly any process used in the production of such a vitally important part of the automobile must be dependable.

The manufacturers of the "Centrifuse" brake drum claim that cast iron is the most desirable material for the braking surface. Their product is therefore made of a combination of metals. There is first made a steel duplex foundation ring, formed from strip stock in four operations, like a wheel ring. The thickness of the steel varies with the drum size and the brake load. A cast iron friction surface is then bonded to the inside of the duplex ring by centrifugal fusion, so that there is an iron ring of high density inside the steel ring, the outer flanges of the steel ring serving as a mold to hold the molten iron in place. This duplex ring is then cut apart, each half making one drum ring which after cutting is finish-cut and trimmed. The back of the drum, a steel stamping with 12 projections, is then placed on the ring and at a single operation the 12 projection welds are made in a 1500 k.v.a. projection welder. The output of one machine is 400 drums per hour. In addition to the high safety factor and the extremely economical production rate, it is pointed out that in this type of drum, the comparatively heavy body of metal in the brake ring acts as a storage reservoir throughout which the braking heat is distributed and rapidly dissipated through the back of the drum. In other words the better heat transmission obtained through this novel application of projection welding promises an improvement in the service life of the brake as well as complete safety.

Another resistance welding application where safety is of the utmost importance is the wire automobile wheel. The welded construction of the Ford wheel has been given considerable publicity. It is interesting to note that there is no record of a collapse of one of these wheels. The rim is formed of flat stock and the fact that it is dished after welding is in itself a splendid test of the weld. It is claimed that this wheel is twice as strong as any other wheel of the same weight, and 20% lighter than the old type of wheel. This combination of strength and lightness results in better acceleration, although there are probably few drivers who realize this.

Improvements in the resistance welding field have not been confined to spot welding. The butt welding process has been greatly improved with the advent of flash welding in which all oxidized metal is squeezed out of the joint and the bond made between two pieces of fused virgin metal.

Seam welding, which several years ago was used only to a limited extent, has been revolutionized by new methods of current control. Some of the first seam welds were little more than a series of overlapping butt welds, the process being frequently referred to as "stitch welding" at that time. The introduction of a current interruptor changed the picture. New types of current interruptors make possible further refinements of the process so that results are being obtained today which were totally impossible with the equipment used a few years ago. This is especially true of welding special alloys and non-ferrous metals. As an example, there is cited a test made of seam-welding Everdur, a silicon-copper alloy. Two plates of this metal were seam welded together as shown in the illustration. Then one of the plates was tapped inside the area included in the weld, and the test piece was blown up by hydrostatic pressure to 400 lbs. without any collapse in the weld, although the test piece had assumed the appearance of a pillow by that time. Similar results are being obtained in the welding of the stainless steels. An alloy called Elkaloy is used for the wheels in these applications of seam welding.

It was pointed out that these more recent applications of resistance welding in which safety must be absolutely assured cannot be put on a production basis with old fashioned types of equipment and that the production rates cannot be matched except by using machines of the most up-to-date design. Automatic control and automatic operation are essential.

Much of the progress made during recent years is due to the use of materials specially made for electrodes and welding dies. Copper was considered to be the ideal welding material for many years on account of its high electrical conductivity but its tendency to mushroom was against it. The addition of tungsten increases the hardness without increasing the resistance sufficiently to be a serious handicap to the operating efficiency. It is necessary, however, to take into account the fact that the tungsten shows increased resistance as it is heated and therefore give careful attention to cooling the electrodes and dies.

Just as the copper-tungsten alloy has contributed largely to the development of resistance welding, so the tungsten carbide alloys, such as Carboloy, have contributed to new advances in the machining of metal parts. This alloy is extremely hard and brittle and when used as cutting edge for machine tools shows two advantages: First, that it makes possible the production of a great many more parts before grinding; and, second, that these parts can be held to extremely close tolerances. In other words, more accurate work can be done at a smaller production cost.

Building a Job Welding Business

By W. Irving Brockson

XII—Know Your Costs of Doing Business

"JIM, how much does it cost you to weld a one-foot seam on five-sixteenths inch steel plate?"

"Get down to cases, George, what kind of steel is it, are you using gas or electric welding and what kind of rod are you using?"

"Well, let's say a low carbon steel with flux coated rods by the electric process."

"I don't know as I could say offhand, George, so much depends on other conditions."

And after that indefinite statement two job welders attending the recent South Bend Convention turned their conversation into other channels.

If you were asked a similar question, could you answer it with any degree of accuracy? What are some of those "conditions" which enable one welder to turn out a given job at a profit and another welder to produce almost identically the same job at a loss. Does not the answer to these questions in any individual case, lie in the cost records which the shop operator keeps?

Right here it should be emphasized that the lack of information regarding costs brings about a high percentage of business failures; and obviously costs cannot be determined without proper records and bookkeeping.

For example, during 1929 and 1930 the U. S. Department of Commerce made a study of 612 cases of bankruptcy and other failures in New Jersey. Poor bookkeeping was listed as one of the important factors causing these failures. "Of 408 businesses for which information was secured on this point, 96 (23½%) kept no books at all, 120 (29.4%) kept books which were inadequate for the purpose of showing the condition of the business, and 192 (47.1%) kept books which might be described as adequate.

"The lack of records is frequently accounted for by owners on the ground that the businesses are small, that the owners are too busy, or that they cannot afford to hire qualified bookkeepers or accountants. However, if one may judge the size of these concerns by their liabilities, which indicate the amounts of money that went into them, some of the largest kept either inadequate records or none at all."

Determining Charges for Jobs

One of the first places where the need for an adequate cost record system becomes apparent is in making charges for individual jobs. Without this knowledge, the job shop owner cannot set a price which is fair either to himself or to the customer. Sad to relate, only too many prices are set on the basis of what competition may do or "What the traffic will bear."

It should be understood at the outset that this is not a plea for complicated, mystifying systems of cost accounting bearing high sounding names. It is meant to call attention to the fact, however, that some simple, workable, common sense method of bookkeeping and cost keeping is just as essential to the success of a job welding business as practical welding skill. Naturally, your cost records should be operated in conjunction with your bookkeeping plan, a subject which was discussed in a preceding article in this series.

After any cost checking system has been in effect for a few weeks or months, it should be carefully checked. Furthermore, it should be rechecked periodically thereafter and changes made as conditions vary.

Important Cost Elements

The average job shop owner fails to include in his costs all of his expenses of doing business. The question of overhead expenses is frequently overlooked entirely. Here are some of the more important elements which go to make up job welding shop costs:

Rent	Labor
Heat	Light
Welding currents	Welding gases
Welding rods	Miscellaneous welding supplies
Truck expense	Interest on borrowed money
Interest on money invested	Obsolescence and depreciation
Telephone	Sales expense
Advertising	Telephone Directory, Direct mail, signs
Stationery and Office Supplies	Insurance
Reserve for doubtful accounts	Miscellaneous Contingency

It is needless to discuss all the above items, but some deserve special comment.

Rent. If the building is actually being rented this item will readily show on the books as a matter of expense. However, if the welding shop owns its own building, this item is frequently overlooked. In this latter case, the interest on the money invested in the building, insurance, taxes, repairs and depreciation are some of the items with respect to the building which should be classified under the heading "Rent."

Labor. Paying hired help is an all-too-important problem with the shop owner ever to be forgotten. On the other hand, many operators forget to charge for their own labor. All authorities on accounting agree that the owner should pay himself a definite salary and add it into the cost of doing business. Most shop operators are both laborers and managers. The wages or salary they get is their compensation for their efforts as laborers and the net profit at the end of the year is their compensation as managers.

Interest. Interest on borrowed money is another item which readily appears on the books. However, interest on money which is invested in machinery and equipment does not show so readily, but it nevertheless is an item which should be added into the cost of doing business. If the money had not been invested in welding machines, torches, cutting devices, etc., the owner of the money would have been free to invest it in government bonds, mortgages, or other securities yielding regular interest. As a result the shop owner has a right to charge the customer for the use of his money.

Obsolescence and Depreciation. Did you ever hear anyone say: "I can undersell my competitor because I

have my machinery paid for." The equipment may be paid for, but what will happen when it wears out? In handling this item it is considered good practice to estimate the life of a machine or other item of equipment and divide the original cost by the number of years of expected life. The amount arrived at should be charged off each year as Depreciation or Obsolescence.

Loss On Bad Accounts. If the business is fortunate enough to be able to operate on a strictly cash basis, this item, of course, has no place in costs, but wherever a credit system is followed, it is reasonably certain that there will be credit losses over a period of years. Perhaps the business may operate for several months without such a loss, then suddenly, "out of a clear sky" an account which has been considered good will go bad. Many successful businesses follow a practice of setting up a reserve of about 1 per cent of their gross sales as a protection against bad accounts.

Miscellaneous and Contingencies. It matters not how well a business may be planned, there are always expenses which are not foreseen. Sometimes these are large and sometimes small. To provide for such emergencies there should be a "Miscellaneous and Contingency" Account.

With all of the above information at hand the job shop operator is in a position to arrive at the cost of doing individual jobs with a reasonable degree of accuracy. Just how the above costs can be prorated on a yearly basis to a particular job is a matter which each operator will have to work out for himself. So many variable factors come in that it is impossible to set a general rule. Here is another case where the operator should get the assistance of some experienced bookkeeper or accountant in order to put in a system which will be applicable to the business in question.

Theoretically if one had before him the total cost of doing business over a period of one year, and then by some magic could know the total number of jobs which would come in over the next year, it would be simple—if each job required the same amount of labor and materials—to prorate the cost per job. Again, if it were possible to know the exact number of hours of labor which would be put in over a period of one year, it would be a relatively easy matter to arrive at a figure to be charged a customer for one hour's work. These two assumptions will form an excellent starting point from which to build a system designed to prorate accurately the total cost of operations over each job.

If one is just starting in business, some items of expense must necessarily be estimated and these expenses studied in the light of business which can be reasonably anticipated.

After the cost system has been in operation for a year or more, it is a simple matter to compare the total cost figures with the total amount of business, and arrive at a cost per unit. Naturally it is well to take into consideration competitive prices, but this alone should not govern the prices you charge for your work.

Pacific Northwest Welding Congress Has Varied Program

One hundred and twenty-five welders and equipment men, considerably more than had been anticipated, attended the opening session of the Pacific Northwest Welding Congress, which was housed in the Auditorium, Portland, Oregon, giving ample space to an increased number of interesting and instructive exhibits. Chief of Police Jenkins, in the absence of Mayor George L. Baker, welcomed the group to Portland, and A. Whisnant, manager of the Congress, responded, followed brief talks by George C. Dierking, president, and J. S. Beall, past president, the veteran pipe men of the Pacific northwest.

"Modern Trends in Industrial Development" was the subject of an address by Dean H. J. Rogers, Corvallis, Oregon, who is given credit for initiating welding congresses in the Pacific northwest. He outlined briefly previous conferences held at Corvallis where 20 percent of the attendance were shop men. He noted the struggle of the welding industry to overcome early prejudices and cited the splendid record of the American Welding Society. He gave his hearers just a glimpse of the rolling of new tee-shapes instead of angle shapes. It was Mr. Rogers' belief that there is a big job ahead for every mechanic who fits himself for it, and that during the present lull was the time to do it.

Public demonstrations were held in the Exhibition Hall, following which was a paper by A. G. Bissell, of Seattle, Wash., accompanied by moving pictures of welding operations. Discussions were held following each picture, on the modern methods of cutting and joining metals—Steel Tank & Pipe Company's operations—Welded Industrial piping, hard surfacing, etc. The remaining papers on the program were as reported in the April issue of *The Welding Engineer*.

It was brought out during the convention that numerous welding shops in this section are endeavoring to keep their force at work through diversified and generally smaller jobs than in past years. New uses are continually being discovered for welding and operators, themselves, are studying their jobs more than ever before.

A most attractive booth was that of King Bros., under the personal supervision of Fred C. King. They report a most satisfactory welding job on the jail and corridor doors at Hillsboro. This work brought them the order for 180 steel doors in the new addition to the State Penitentiary at Salem. Also in their exhibit was shown a tank job and the test welds which held with 2250 lb. tests. Of considerable interest also were their welded steel burial vaults, which are finding a ready sale.

J. E. Haseltine & Company, had a variety of welding apparatus on display, principal of which were the General Electric arc-welders—Victor Oxy-Acetylene. Photographs of unusually intricate pipe job recently finished at the Longview Fibre Company, welded by General Electric—a special bend job showing five joints.

Scott Merriam, manager of Hobart Sales & Service, was in charge of that exhibit and displayed a complete line of Hobart "Constant Arc" Welders.

Air Reduction Sales Company, Wilson Welder & Metal Company, had their usual attractive and instructive exhibit.

Among the other exhibits were—Clyde Equipment Co., of Portland and Seattle, Pacific Northwest distributors for Lincoln Electric Co.—Wickwire Spencer Steel Co., Woodbury & Co., showing the Westinghouse line; The American Welding Society booth securing additional members. The Welding Apparatus Repair Station, W. E. Hayden, 493 Union Ave., N., Portland.

Planning Homes of the Future Subject of A. I. S. C.

Sponsored by the American Institute of Steel Construction, a forum on constructing residences with the use of modern building materials will be held May 24 and 25 in the auditorium of the Engineering Societies Building, New York. It is open to builders, architects and all persons interested in the development of more economical methods of house building. Modern homes should not only be firesafe but should resist deterioration, if we hope to reduce the cost of housing.

Can the cottage be factoried and sold complete or in units to the owner? If the house is tailor-made, what materials make for better construction and what specifications offer the best chances of successful results? These are some of the questions to which answers are sought. Builders and others who participate in the discussions will be asked to submit drawings, plans and exhibits.

The record will be turned over to a committee of experts who have been requested to analyze it and make a report thereon together with recommendations.

Tuesday night, May 24, the delegates to this forum are invited to attend a "Stainless Steel Symposium," to be held at the same address beginning 8 p. m. This symposium will treat of stainless steel with special emphasis on the architectural uses. It is called by the New York Section of the American Welding Society.

Large Attendance Expected at Alabama Welding Conference

Officials in charge of the First Southwide Welding Conference which is to be held at Alabama Polytechnic Institute, Auburn, Alabama, during the week of May 23rd, have been diligent in spreading the news of this event throughout the southern states and in making preparations for attending to the comfort and convenience of visitors. It is reported that on the basis of the favorable comments and inquiries received during recent weeks, it will not be surprising if the registration totals over a thousand visitors. Printed programs are now ready for distribution and can be obtained from Prof. Dan T. Jones, Alabama Polytechnic Institute. The program includes about two dozen papers, the titles of which were reported in the April issue of *The Welding Engineer*. In addition to this there are many special demonstrations to be given in the space which has been set aside for this purpose in the shops.

Tool Engineers Form Society with Headquarters in Detroit

The American Society of Tool Engineers, composed of members connected with the various branches of the tool industry in Detroit, Pontiac, Flint, Lansing, Saginaw and Bay City, Mich., has been formed with headquarters at 8316 Woodward Ave., Detroit. J. A. Siegel is President and A. M. Sargeant is Secretary. The purpose of the society is to advance the arts and sciences related to the machine tool industry and to hold meetings for the exchange of information. Regular membership meetings are held on the second Thursday of each month. A meeting was held on the evening of May 12th at the Hotel Webster Hall, Detroit. H. A. Woofter, Chief Engineer of the Swift Electric Welder Company, was the principal speaker, his subject being "Spot, Butt and Projection Welding in Production."

Chicago Section, A. W. S., Hears About Resistance Welding

At its May meeting, the Chicago section of the American Welding Society had as speaker, G. N. Sieger of P. R. Mallory, Inc., Indianapolis, Ind., whose subject was "Welding and Cutting with Elkonite and Carboloy." This was an exceptionally interesting and complete discussion of the many applications of resistance welding in industry today. Mr. Sieger presented some pertinent data on present day fabrication methods, particularly in the automotive field. He closed his discussion with details of the proper use and preparation of metal cutting tools.

Since the April meeting, several of the welded specimens, which were X-rayed and discussed at that time, were prepared for tensile test and pulled to determine their breaking point. Claude S. Gordon and Wm. G. Praed of the Claude S. Gordon X-Ray Laboratories who furnished the X-ray films for the April meeting were on hand to discuss the data obtained by these different methods of testing and show the relation of one to the other.

This was the last meeting of the Chicago section until October and at this time the newly elected officers were installed, as follows: Chairman, C. C. Whittier, Robert W. Hunt Co.; Vice-Chairman, J. B. Green, Fusion Welding Corp.; Secretary-Treasurer, M. S. Hendricks, THE WELDING ENGINEER; Directors for three years, J. W. Haygood, Linde Air Products Co.; A. F. Krumholz, Chicago Boiler Works, Otto Voss, Allis Chalmers Co., and I. B. Yates, Bryant Machinery & Engineering Co.

Steel Castings Symposium Next Month

The American Society for Testing Materials and the American Foundrymen's Association are sponsoring a Symposium on Steel Castings which is to be held in two sessions of the approaching A. S. T. M. annual meeting in Atlantic City. The sessions are scheduled for Tuesday afternoon and evening, June 21.

Ten papers are listed for presentation covering many of the important technical phases of steel castings such as methods of molding, casting, use of alloys and heat treatment. One of the important contributions is a paper on welding which discusses this subject from the standpoint of a steel foundryman. The title is "Fusion Welding as Related to Steel Castings" and the author is T. S. Quinn, Treasurer, Lebanon Steel Foundry.

Annual Meeting of Philadelphia Section Has Good Attendance

There were over 100 members and guests present at the April meeting of the Philadelphia section of the American Welding Society held Monday, the 18th, to hear F. Eder of the New York office of Robert W. Hunt Co., talk on "Inspection of Welded Steel Framing in Buildings." This was the annual meeting of the eastern group and on this occasion the officers who had served the previous year were reelected as follows: Chairman, L. H. Christensen; vice-chairman, Charles M. Rusk; secretary, H. E. Hopkins; treasurer, R. D. Thomas and members of the executive committee to serve for three years, Jos. Meadowcroft and A. G. Desch.

For the May meeting which will be held on the evening of the 16th, E. V. David, Applied Engineering Dept., Air Reduction Co., will present a paper, "Theory and Practice of Oxy-Acetylene Cutting" which will be illustrated by lantern slides. The revised film "Oxygen the Wonder Worker" will also be shown at this time. This meeting will conclude the sessions of the Philadelphia section until next September.

Westinghouse Follows Through on Local Newspaper Publicity

As the golfing season gets under way, the players have been giving the usual early season attention to the "follow through." The Publicity Department of the Chicago branch of the Westinghouse Electric & Mfg. Company has recently given a good demonstration of the use of the "follow through" in business. Shortly after Mr. J. G. Ritter, one of the company's welding experts, made a talk before a building trade group in Chicago, a generous portion of his talk was reproduced in one of the local newspapers. The Chicago publicity department clipped this item from a number of copies of the newspaper and pasted it to a memorandum reading, "Did you see this article in the Chicago *Evening Post* April 2, 1932? Would you like to have our welding engineer call with complete information on the welding of structural steel?" This memorandum with the newspaper clipping pasted to it was mailed to a select list of architects and builders for the purpose of seeing to it that the newspaper publicity received attention in places where it would do the most good.

Coleman Electrical School Has Correspondence Course

For several months the Coleman Electrical School, Kansas City, Mo., has had in preparation a correspondence course in oxy-acetylene and electric arc welding and have recently issued a folder describing the course in detail. There are twenty separate lessons in oxy-acetylene welding and there is included with the course a complete oxy-acetylene welding outfit with a supply of various kinds of welding rods. The purpose of the correspond-

ence course is to put fundamental training at the disposal of those who are not in a position to travel and spend the necessary time in a welding school. The instruction material includes nearly 300 sheets of text and this is supplemented by a consultation service maintained by the school. Regular resident courses are also offered to those who are able to go to Kansas City for shop training.

An Underwater Cutting Job Speeds Up Reconstruction

By P. Thurston

Two steel pipes, each 9 feet in diameter, have been cut by an underwater torch in speeding up reconstruction work at the Plaquemines-Jefferson drainage district pumping station on Harvey Canal, New Orleans, engineers of the Sewerage and Water Board have announced. Sewerage and water board engineers say that use of the instrument at the pumping station marked the first utilization of an underwater torch in the South. The two pipes were cut by the torch and removed by a derrick.

The torch used has a special attachment designed to keep the flame burning steadily under water. This attachment requires the use of electricity, which provides steady sparks to ignite the work. Current is provided by a surface generator driven by a gasoline motor. The torch was built by James J. Evans, diver, and E. E. Longley of New Orleans.

American Steel and Wire Announces New Warehouse Location

For years the American Steel & Wire Company, a subsidiary of the United States Steel Corporation, has served the users of wire and wire products in the Chicago district from its local warehouse at 403 West Lake Street. But the old must give way to the more modern—even in warehousing and distributing. At its new Chicago warehouse, located at 2364 South Ashland Avenue, which supplants the Lake Street location, the company will have the advantage of a near south side location.

Los Angeles Section Has Fine Programs Scheduled

The Los Angeles Section of the American Welding Society has been doing splendid work in the southern California district, and the current programs of the section are attracting a great deal of favorable attention among people interested in welding. Turner C. Smith, the new chairman, is getting good support from the Program Committee and has appointed for the coming year new committees to work on the subjects of pressure vessels, pipe welding, structural welding and job shop welding.

At the meeting which was held on March 24th, Stanley Levyn of the Acme Electric Welder Corporation, Huntington Park, Calif., delivered a comprehensive paper covering resistance welding, and reviewed the principal industrial applications of the process. At the same meeting, C. E. McGinnis gave a short talk on the work which is being done toward revising the pressure vessel and piping code of the city of Los Angeles.

At the April meeting, which was held April 21st, there were short talks by Paul Jeffers of the Pressure Vessel Committee, J. J. Bruton of the Piping Committee and J. O. Killiam of the Membership Committee. These talks were in the nature of committee reports and were followed by a talk by F. A. Page, Supervising Engineer of the Boiler Inspection Division of the California Industrial Accident Commission, relative to the new, tentative California code on air tanks and unfired pressure vessels. The principal speaker of the evening was John Weaver, Engineer of the Douglas Aircraft Company, who talked on the welding of aircraft fusilage and aluminum tanks. He described the various operations involved in the making of welded products and discussed the type of supervision and training necessary to obtain uniform production. Following the meeting was an inspection trip to the Douglas Aircraft plant in Santa Monica.

C. J. Nyquist, Chairman of the Program Committee of the Los Angeles Section, announced that the May meeting will be held on May 19th at the Frank Wiggins Trade School. An interesting educational program is being planned for that meeting.

G. E. Course in Welding Design Uses Problem Method

The course in design of arc welded structures recently established by the General Electric Company at its general office in Schenectady is reported to be running at full capacity almost from the start. An important feature of the instruction given is the working out of a series of problems which bring into use all of the fundamentals of good design where arc welding is to be used for steel structures. In this way, the students acquire an actual working knowledge of the principles involved. Special arrangements have been made by instructors in several of the large engineering colleges to spend a portion of the summer at Schenectady and take this course.

The Book of Metals: Wilhelm Book Review

In this modern age, the multitude of metals play an important part in our every day life. They enter into almost every commonplace activity of our daily activities in one way or another, many times without our being aware of the part they play. How they play this part, how they are mined, worked and used in business and industry are vividly discribed in "The Book of Metals" from the pen of Donald Wilhelm, just published by Harper & Brothers, 49 E. 33rd St., New York City.

The author has presented his material in simple, non-technical narrative. His facts have been gathered from every point where authentic information was to be obtained. In addition his data has been checked by authorities in every field that he covers which include all the metals now in use as well as many of their alloys.

The information in this text is valuable to every one in any way connected with the metal working industries from executives and their salesmen down to young men who are deciding on careers. The illustrations effectively set forth many of the operations covered. The price of the volume is $4.00 and may be obtained from the publishers.

Taylor-Winfield Folder Describes Varied List of Resistance Welders

A loose-leaf folder entitled "Progress" recently issued by the Taylor-Winfield Corporation, Warren, Ohio, describes over 90 different resistance welding units and auxiliary equipment of their manufacture. These machines range from small portable and foot operated spot welders up to large heavy machines which have been designed for joining automobile body units.

Crane Company Issues Complete Catalog of Welding Fittings

A 44-page catalog of welding fittings and flanges has recently been issued by the Crane Company, 836 So. Michigan Ave., Chicago. The fittings described include 90-degree elbows, 45-degree elbows, return bends, tees, reducing nipples, caps, welding neck flanges, slip-on flanges, Cranelap nipples and flanges and reinforcing saddles. There are several pages showing the method of installing these fittings for different types of pipe installations. Complete specifications are given for all of the fittings listed and prices for various sizes. Of particular interest is a collection of illustrations of typical applications showing how many difficult pipe assemblies can be made using straight line butt joints throughout when full advantage is taken of stock fittings.

Schramm, Inc., Issues New Bulletin on Welders and Compressors

Schramm, Inc., manufacturers, West Chester, Pa., are announcing their new Bulletin 3225 covering their entire line of engine driven arc welders.

This bulletin not only illustrates the various mountings furnished by this manufacturer but also includes complete description of the single and double arc 200-, 300-, 400-, and 600-ampere welders for industrial use and describes the railroad type self-propelled variable voltage welder used for repairing battered rail ends, frogs and switches, strengthening old bridges, etc.

Another innovation is the constant voltage two-arc rail car welder in which generators are compounded so that with 3000 ft. of welding cable in the circuit, 225 amperes flow through the arc at normal arc voltage and a surplus current is available for grinders and other tools.

Other combinations include compressor welders, welder compressors, tractor mounted welders, trailer mounted and many other types of outfits.

Beam to Column Flange Connections Described in Lincoln Bulletin

Plates 34 and 35 of the Lincoln Electric Company's series on structural arc welding describe several methods of making free end connections between beams and column flanges. An angle seat is shown to be satisfactory for light loads, while an I-beam cut in two longitudinally can be used where greater strength is needed. For heavy beams a stiffened angle seat is suggested with plug welds for added strength. Several methods are also described and illustrated of making such connections when the beam is not symmetrical with the column. In the "Elements of Design" series several methods of making arc welded levers are shown.

Second Edition of Hobart Manual Ready

Hobart Brothers Company, Troy, Ohio, have just issued the second edition of their booklet on Electric Arc Welding. This is a pocket size volume explaining in non-technical language the principles of arc welding and giving sufficient instruction material to get the new operator properly started in the right direction. Information is also included to show the great variety of uses to which the process can be applied.

Eisler Electric Issues New Spot Welder Catalog

Eisler Electric Corp., 744 So. 13th St., Newark, N. J., has just issued a 24-page catalog describing their line of speed spot welders and accessories. These include units from ½ to 50 K. V. A. capacities both foot and power operated. Many illustrations show the construction and operation of the Eisler machines and the scope of work that they are built to handle. In addition a wide variety of electrode holders for many types of work are illustrated. Copies of this catalog can be obtained by writing the company at the address above.

Arc Welding Supplies Catalog Issued by Lincoln

The Lincoln Electric Co., Cleveland, Ohio, manufacturers of arc welders, welding electrodes and supplies have just issued a new 24-page catalog of the arc welding supplies which includes fleetweld, stable-arc, anode, stain-weld, hard surfacing and non-ferrous rods as well as shields, holders and other accessories. Copies may be obtained by addressing the company.

Booklet Explains the Metallurgy of Welds

Under the title "'M. W. P.' Welds Under the Microscope," Murex Welding Processes, Ltd., London, England, has issued a 16-page illustrated bulletin which gives interesting information on the metallurgy of welds. Microphotographs are used to show the structure and composition of various grades of wire and of welds made with different wires. Many different types of deposit are shown; the structure is explained, and information is given regarding the physical properties of the metal as brought out by laboratory tests. The study includes not only low carbon steels but manganese steels and acid and heat resisting steels.

New English Booklet Published on Oxy-Acetylene Welding

The British Oxygen Co., Ltd., London, England, have just published a 68-page booklet in pocket size entitled, "Hints on Oxy-Acetylene Welding." The information in the book covers the fundamentals of the process and describes the correct procedure for obtaining sound welds and satisfactory results. The following taken from the Foreword —"There is a right and a wrong way of doing everything. The right way means satisfaction and success, the wrong way leads to disappointment and failure. . ." which adequately describes the purpose of the publishers of the book.

Highland Iron & Steel Co. Announces Alloyed Puddled Wrought Iron

A new development in the manufacture of wrought iron is announced by The Highland Iron & Steel Co., an associate of the American Chain Co., Inc., in a recent statement that they are now in production on wrought iron alloyed with nickel, with copper, with nickel and molybdenum and with copper and molybdenum. Several years of intensive research work preceded actual production.

It is said that this development of alloyed wrought iron opens greater fields of usefulness for this material without changing in any way its fibrous structure which is responsible for the endurance of wrought iron under vibratory stresses, but at the same time has resulted in a 25% increase in the strength of the material in the as-rolled condition.

Of these alloys, wrought iron with nickel alone and with nickel and molybdenum have outstanding characteristics. Both have shown a marked increase in fatigue-resisting properties. Heat treated nickel and nickel and molybdenum alloyed wrought iron shows an increase in strength of 40% to 50% over ordinary wrought iron.

Lincoln Perfects Improvements in Push Button

The Lincoln Electric Co., Cleveland, Ohio, announce a number of improvements in their safety push button introduced to the trade early last year.

A feature of this push button switch is that the start button is inside of the stop button, which can be operated from any angle by merely striking the front of the control box with the flat of the hand, but the start button must be operated with the finger. With the new push button, the stop button can be locked in the off position by pushing it in and twisting it to the right. Heavy springs prevent accidental operation of either button when not locked.

It is claimed the button will handle the heaviest control circuits up to 600 volts A.C. or D.C. because the contact opening is larger than usual. This is because the contacts use extra heavy double break solid copper contacts which have a positive wiping action. Contacts are enclosed in a dustproof, cold moulded asbestos case.

The button is self contained and need not be taken apart or even removed from the box cover for wiring. All of the terminals are clearly marked and brought out of the case to the back where they are easily accessible. The new safety switch is known as type A-31.

Bastian-Blessing Announces New Welding Rod Line

Under the trade name of RegOroD, The Bastian-Blessing Co., Chicago, Ill., has recently introduced a new line of welding rods and electrodes to be sold through their distributors. Research and field tests have been made in the development of this line, which includes all popular types of rod such as high speed and high test materials. Bundles are identified by a distinctive shield tag in red and black, which bears the trademark and the identification symbols. The new RegOroD catalog is prepared in pocket size and not only gives a complete description of each rod but gives valuable information in reference to the number of tables for the use of the welder and welding engineer.

The introduction page says in part: "In the average job the cost of welding rod is less than 2% of the total cost of labor and material for the completed job. It is obviously poor economy to attempt to save a cent or so in the cost of rod if by so doing the entire investment in labor and materials of the completed weld is jeopardized."

Hobart Brothers Announce Railway Welder

In Bulletin No. E-36, Hobart Brothers Co., Troy, Ohio, describe and illustrate arc welding equipment designed for shop welding and track welding on railroads. The welding unit is gas engine driven, the engine equipped with self-starter and connected directly to the

Hobart Welding Unit for Railroad Track Work.

generator. The engine has a special heavy duty welded steel radiator with large fan and air control cabinet. Special equipment includes an enclosed cable reel, lifting bail, insulated flanged wheel car with hand brakes, pin-type coupling and adjustable set-off wheels. An electric motor with reversible controls can

be furnished, operating on current supplied by the generator, with chain drive on one axle to propel the car in either direction. The set-off wheels are of the eccentric ratchet type. One man can raise or lower one corner at a time, or one man at each corner can raise it all at once. Stationary set-off wheels may be had if preferred. The two operator equipment can be supplied in which two standard Hobart welding units are used instead of a very large engine coupled to two generators, so that the operators do not interfere with each other, and one complete unit can be used elsewhere when only one operator needs the car.

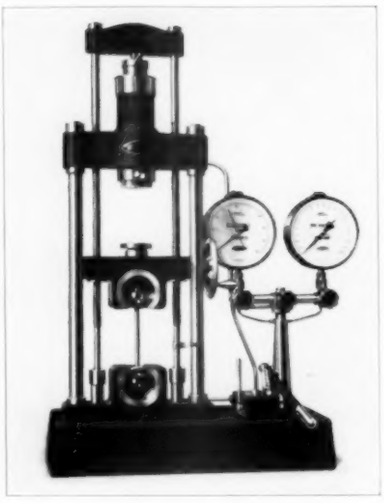
Marketing New Testing Machine of Low Capacity

A new type of testing machine, Model MP-10, moderately priced, shown in illustration, is being placed on the market by the Steel City Testing Laboratory, 8843 Livernois Ave., Detroit, Mich., for testing specimens in tension, transverse, bending and compression. This machine is being built for foundries, sheet metal, wire, cable, and welding plants, technical schools, as well as many other plants where a machine of low capacity (22,000 lbs.) will suffice.

Outstanding features of this apparatus are finely fitted non-packed plunger, vertical adjustability of the upper pulling head, two measuring ranges, versatile applicability, easy to operate, space saving, convenient working height, self-contained and accuracy. The machine can be supplied for hand or motor drive.

This machine is for practical daily use, ready for operation at all times, and permits easy determination of elastic limit, yield stress, tensile strength and elongation of all kinds of material at little cost. The complete machine and accessories are designed and constructed according to the latest developments for scientific material testing.

Prospectus and special information will be furnished to interested parties.



Model MP-10 Testing Machine with Capacity Up to 22,000 Pounds.

Direct Controlled Heating by Electric Resistance Method

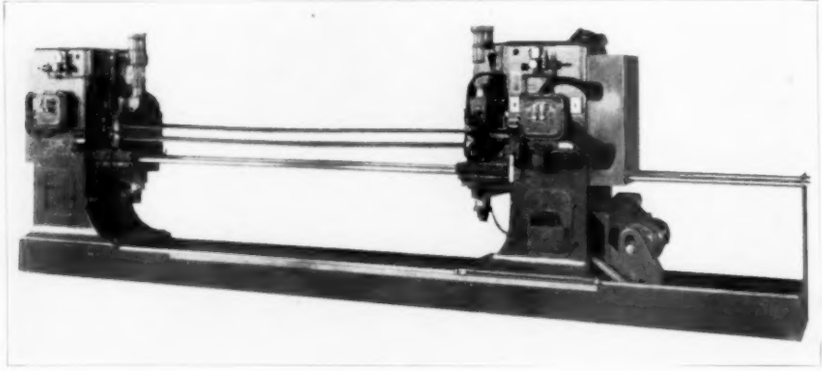
The unit shown is a special application of direct controlled heating by electric resistance method, and was developed for rapid soldering of parts consisting of from three to twelve copper tubes on which are assembled a large number of flanged fins, each of which must be thoroughly soldered to each tube for good thermal contact. The tubes are covered with solder, the fins assembled, soldering acid applied, the complete unit clamped in machine, current turned on, and in less than a minute, or more, depending on number of tubes and their length, the entire assembly is thoroughly soldered.

One machine is fixed on the base and the other is adjustable along the base through distance of 10 feet by means of motor driven worm reduction unit, spur gears, and rack; motor having reversible drum control. Adjustable time relays are provided to give definite time of heating work.

Clamping of work is by means of air cylinders and all work clamping jaws are adjustable and special provision is made for uniform clamping pressure and distribution of current to all tubes to insure uniform heating.

Each machine of the duplex unit carries its own transformer, one side of each secondary being connected to heavy bus bars, the work being heated forming the other side of secondaries.

This method of direct controlled heating by electrical resistance has applications to many similar classes of work besides soldering, such as heating for annealing, heat treating, heating for forging, bending, etc. The machine is manufactured by Thompson-Gibb Electric Welding Co., Bay City, Mich.



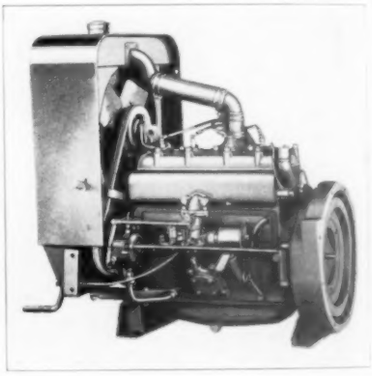
Direct Controlled Heating Unit for Soldering, Annealing, Heat Treating, etc.

Continental Introduces New Motor for Lower Power Ranges

Continental Motors Corporation has just announced another 4-cylinder model engine of 74.83 cu. in. displacement for industrial application to be known as Y400, and its corresponding power unit as P410. This engine is of $2\frac{1}{4}$" bore and $3\frac{3}{32}$" stroke and develops 10.75 H.P. at 1200 R.P.M., the recommended governed speed, and 17.8 H.P. at 2000 R.P.M.

For power needs in the lower ranges and particularly for low weight equipment of portable type, this engine weighing only 250 pounds—or 350 in power unit form including carburetor, magneto, governor, fan, radiator, gasoline tank, controls, base supports and sheet steel housing—is said to be particularly adaptable.

The Y400 has been designed to meet a demand for a smaller unit to handle pumps, compressors, generators and like units for which a growing market appears in these times of individual power applications in the lower ranges.



Low Power Range Continental Motor, Model Y400.

The power unit mounting is of the base type with a rear support angle attached to the flywheel housing, and a pressed steel front support. Radiator and gasoline tank may be mounted without using the usual power unit housing.

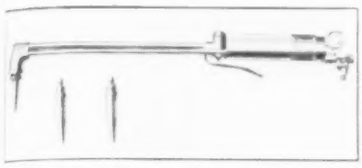
Provision is made for heavy duty clutch and power take-off. Stub shaft for direct drive connection may be readily bolted to the flywheel. Reductions, with or without clutch, or right angle drives, can be supplied on order.

New Combination Torch Has Wide Range

Tips, Inc., Baltimore, Md., announce a new cutting and welding torch, Type NVM, as an addition to their line. It is stated that this new unit is highly improved in design and will cut or weld any thickness by mere change of tips. It is designed for the complete range

of work required by welding shops and industrials.

This torch is strongly constructed from carefully chosen materials. The valves and base are of high grade forged bronze and the tubes are special weight, triangularly arranged to give



Type NVM Combination Welding and Cutting Torch.

greatest transverse strength. The high pressure valve is operated with an improved lever underneath the torch which has been designed for simplicity of operation. All replacements can be made without disassembling the torch, as the important parts are accessible from the outside.

New Tractor-Mounted Welder Announced by Schramm

A recent and unique development in welding machines is being announced by Schramm, Inc., of West Chester, Pa. This new welder is of a type that can be mounted on the framework of any standard make tractor and operated by "V" belt drive from the rear power take-off. Similar to the Schramm compressor

New Schramm Tractor with Welder Unit.

mounting, the welder is located alongside the driver's seat on a removable sliding frame. Control panel is on the side opposite from welding unit.

This unit is of the same type used in the Schramm portable engine-driven welders—a single arc, variable voltage design. Sizes, for mounting on tractors of sufficient H.P. rating, include 200, 300, 400 and 600 amperes.

The manufacturers say this complete and compact unit will travel the roughest ground and operate under the same power. Such a machine has widespread use due to the increasing application of welding on pipe lines, railroads, bridge construction, building construction, tank erection and miscellaneous repair work.

The welder mounting does not affect the pulling or towing feature of the tractor drawbar.

News of the Industry

Emil Mollgard, operating an iron working and blacksmith shop at 501 Fourth street, Council Bluffs, Iowa, has completed installation of a new acteylene welding unit, and is now equipped to handle all phases of this work.

King Bros. Iron & Welding Works, Portland, Ore., steel fabricators, are entering the new year with business on hand, and immediate work equal to anything they have had in the past three years. Also inquiries that they have received recently, that will develop shortly, make them feel quite hopeful at this time.

Fred King, secretary and treasurer of the company, reports that they have just completed some nice jobs.

Charles Harden & Company, wholesale mill supply firm, have been appointed Washington distributors for Victor Welding Equipment & Supplies.

The plant of the Associated Manufacturers' Engine Co., Waterloo, Iowa, has been taken over by L. F. Butts who will operate a modern machine and welding shop. A general repair and machine shop business will be conducted.

W. L. Heyn, owner and manager of the Glendale Welding & Radiator Works, Glendale, Cal., contemplates erecting a new building for his shop in the near future. The new building will be constructed of welded structural steel and will be located in the immediate vicinity of the present shop, which is at 747 So. San Fernando Road.

The Republic Steel Corporation, manufacturers of electric welded pipe, has been awarded the contract for furnishing 88 miles of 12¾-inch electric welded pipe for the Southern Counties Gas Company, of Los Angeles, Cal. This pipe will be used for a new natural gas pipe line to extend from Long Beach via Huntington Beach and the Coast Highway to San Diego. The pipe manufacturers state that more than 5,000 miles of Republic electrically welded pipe have been placed in service during the past two and one-half years of its production without a single failure in service. This pipe is formed cold from the flat steel plate, the welding being done by the resistance method.

The Babcock & Wilcox Tube Company, of Beaver Falls, Pa., has opened a new branch office in the Ford Building in Detroit, Mich., with J. E. Polhamus in charge. This company employs high quality welding in the manufacture of their products, and have contributed much in development and scientific research work for the advancement of modern high quality welding. Evidence of this fact was demonstrated in their exhibition booth at the California Oil Equipment & Engineering Exposition held a few weeks ago in Los Angeles, Cal.

The American Tank & Equipment Corporation, of Oklahoma City, Okla., recently completed a heavy welding job in the fabrication of a heavy pressure vessel together with other welding in connection with the installation and erection of a 1,400-barrel refinery for the Octane Oil Refining Company, of Chautauqua, Texas.

Announcement has been made of the appointment of the Pacific Pipe & Supply Company, of Los Angeles, Cal., as jobbers of Tube Turns, factory-made angles and fittings used extensively in pipe welding. Buck & Stoddard are Pacific Coast distributors of this line.

Harold C. Price, of the H. C. Price Company, Bartlesville, Okla., welding contractors specializing in the welding of large pipe lines, recently flew to Los Angeles, Cal., on business for his company. Mr. Price recently completed the electric welding of the major portion of a large pipe line in southern California.

The Welded Products Company, of Bell, Cal., recently took over the business of the Conley Plastering Machine Company, of Compton, and will continue production of the plastering machine in the plant of the original Conley company located on Alameda Boulevard. This machine is of electric welded construction, several important improvements having been made in the machine since it was acquired by the Welded Products Company.

The Allied Research Laboratories, of Glendale, Cal., recently made extensive changes in their sales offices and shipping department. This company recently developed a new all metal solder for the quick repairing of aluminum, pot metal, die castings, cast iron and steel. The trade name of "Alumaweld" has been given the new product.

The 26th annual convention of United Metal Trades Association was held in Seattle, April 23rd, with a record attendance. Of special interest to the welding industry was the address on "Aeroplane Construction," by G. W. Carr, general manager of Boeing Airplane Company, following which he took some sixty representative steel men and press representatives through the Boeing plant.

Officers elected for the ensuing year include Albert Worley, president; Fred C. King, vice-president; Frank McKenzie, vice-president; H. C. Forsberg, secretary and William Casey, treasurer.

John McRae, age 77, head of Coast Iron & Machine Works, died at his home in Tacoma, Wash.

"Red" Smith, formerly connected with the Lynwood Welding Works, of Lynwood, Cal., who has been ill for several months in the Government Hospital at Sawtelle, Cal., is expecting to be transferred to the Government Hospital at Tucson, Ariz., in the near future.

Mr. Crowson, formerly associated with the Emerson-Crowson Welding Works, in Los Angeles, Cal., is now connected with the Reliable Welding Works at 9th Street and Naomi Avenue, Los Angeles.

The Advance Welding Works, of Los Angeles, Cal., recently organized under

the management of the partners Ray Morse and A. Roth, and the new shop has been opened for business at 306 West Slauson Avenue. General welding jobs of all kinds will be handled in the new shop with the special feature of starter teeth welding. The partners also expect to build and market a semi-portable electric welding machine. They recently finished one of these electric units for their own use in the new shop.

Mr. Morse was formerly associated with the Curtis Paving Company, of Los Angeles, and Mr. Roth was connected with the Shrader Electric Company.

L. A. Peters, engineering representative and welding expert for the Lufkin Foundry & Machine Company, Lufkin, Texas, recently returned from a three months' trip to Venezuela, Colombia, and Trinidad. The Lufkin company employs welding extensively in the manufacture of various kinds of oil industry equipment.

Charles T. Watkins, formerly associated with the United Tank & Welding Works, at 708 Date Street, Los Angeles, Cal., recently made new connections and is now with the American Welding & Boiler Works at 4115 Alameda Boulevard. This company features general job welding of all kinds, both gas and electric, specializing on tank building and general boiler work.

C. W. ("Bill") Granneman, well-known welding shop operator of Los Angeles, Cal., recently moved from his old location at 1216 South Grand Avenue, to 2900 South Santa Fe Avenue, where he will continue to operate, featuring electric and oxy-acetylene welding of all kinds. Mr. Granneman specializes in sheet and cast aluminum welding. A new 300-amp. Hobart electric welding machine was recently installed in Mr. Granneman's new shop which unit he has changed over into a combination portable gas engine driven unit for outside work, and, by detaching the gas engine, an electric power driven unit can be easily hooked up for shop work.

D. H. Skeen & Co., 1 North La Salle Street, Chicago, have been appointed distributors in the Chicago territory for Tube-Turns, Inc., of Louisville, Ky. The D. H. Skeen & Co. are also distributor for Bonney Forge & Works, of Allentown, Pa., and the new addition rounds out its line of fittings for welding work.

Central Steel & Wire Co., 4545 South Western Boulevard, Chicago, has been made distributor for the Rustless Iron Corp. of America, Baltimore, in Chicago territory.

"Welding of Pipe Lines" was the subject of a paper by L. M. Goldsmith, of the Atlantic Refining Co., presented before the Philadelphia Section, A. S. M. E. at its meeting April 26.

At the recent annual meeting of the Electrochemical Society the following new officers were elected: President, R. A. Witherspoon, of the Shawinigan Chemicals, Ltd., Montreal, Quebec. Three vice-presidents: Duncan MacRae, E. M. Baker and Sterling Temple. Managers: Acheson Smith, O. P. Watts and W. S. Landis. Treasurer: R. M. Burns. Secretary: Colin G. Fink.

The Allsteel Press Company, 12015 South Peoria Street, Chicago, has received an order from Metal Forms Corp., Milwaukee, Wis., for a Verson Allsteel double crank, triple geared, twin drive press, area of bed 48x140 inches, shaft diameter, 9 inches, shut height to top of bolster, 20 inches, height overall 154 inches. This is believed to be the largest welded steel plate press ever contracted for.

The Burke Electric Company, Erie, Pa., manufacturer of motors, generators and electric welders announces the appointment of George Kuehnle, Jr., as general distributor for the Cincinnati district. Mr. Kuenle is located at 1011 First National Bank Building, Cincinnati. Telephone Main 1346.

A new Bulletin No. WT17 has just been issued on Bonney Weldolets and Thredolets. It contains complete description of the engineering principals of these welding fittings. Working data, tables of sizes, and illustrations of typical installations are also included. Write to Bonney Forge & Tool Works, Forged Fittings Division, Allentown, Pa.

An arc welder in operation and a small display of motors and control featured the General Electric Company's exhibit at the American Mining Congress which was held May 2-7, 1932, at Music Hall, Cincinnati, Ohio. In addition to laboratory demonstrations, various types of welding electrodes and samples of welds were on display.

The purchase by Continental Motors Corp., of the assets and business of Divco Detroit Corporation, manufacturers of a special type retail milk delivery truck widely used by leading dairies, was announced by W. R. Angell, president, on May 5. "The DiVco milk delivery truck is especially designed for multiple-stop delivery and is favorably known for its economical operation and maintenance," stated Mr. Angell. "It is widely used by leading dairies and has been manufactured by DiVco Detroit Corporation for over six years. Continental Motors Corp. has organized a wholly owned subsidiary, Continental DiVco Company, to carry on this business. DiVco milk delivery trucks have been powered by Continental Red Seal Engines exclusively."

Amico Novelty Corp., 16 West 22nd Street, New York City, have just issued a circular on the Bensun Ignitor, an attachment for lighting natural and artificial gas, and designed for use in gas ranges, gas heaters, gas tips, gas mantles, gasoline torches, acetylene torches, etc.

The organization of an Air Conditioning Department within the General Electric Company, which will market various electrical devices for home heating, humidifying and temperature control, has been announced by President Gerard Swope. One of the first products to be marketed by this new department will be a complete oil-burning furnace.

The Lincoln Electric Co., of Cleveland, Ohio, has announced the appointment of the Great Northern Tool & Supply Company as distributors for Lincoln products in Montana and Wyoming.

"Stable-Arc" welders, welding supplies and "Lincweld" motors will be distributed in this territory through Great Northern stores and shops in Billings and Kevin, Mont.; Cody and Casper, Wyo. The main office of the company is at Billings and salesmen cover the state of Montana and the northern half of Wyoming.

C. L. Cornell, welding instructor at the Manual Arts Evening High School, at 42nd Street and Vermont Avenue, Los Angeles, California, recently organized a new class in welding. About thirty students were enrolled in the new class. The course, which includes both oxy-acetylene and electric arc processes of welding, will extend through the balance of this school term and on into the first semester of the next school term.

The Roe Machine and Welding shop, Cassville, Wis., has been purchased by Clyde Clauer, Beetown, Wis., who has taken active management. The concern is one of the largest in this section and completely equipped.

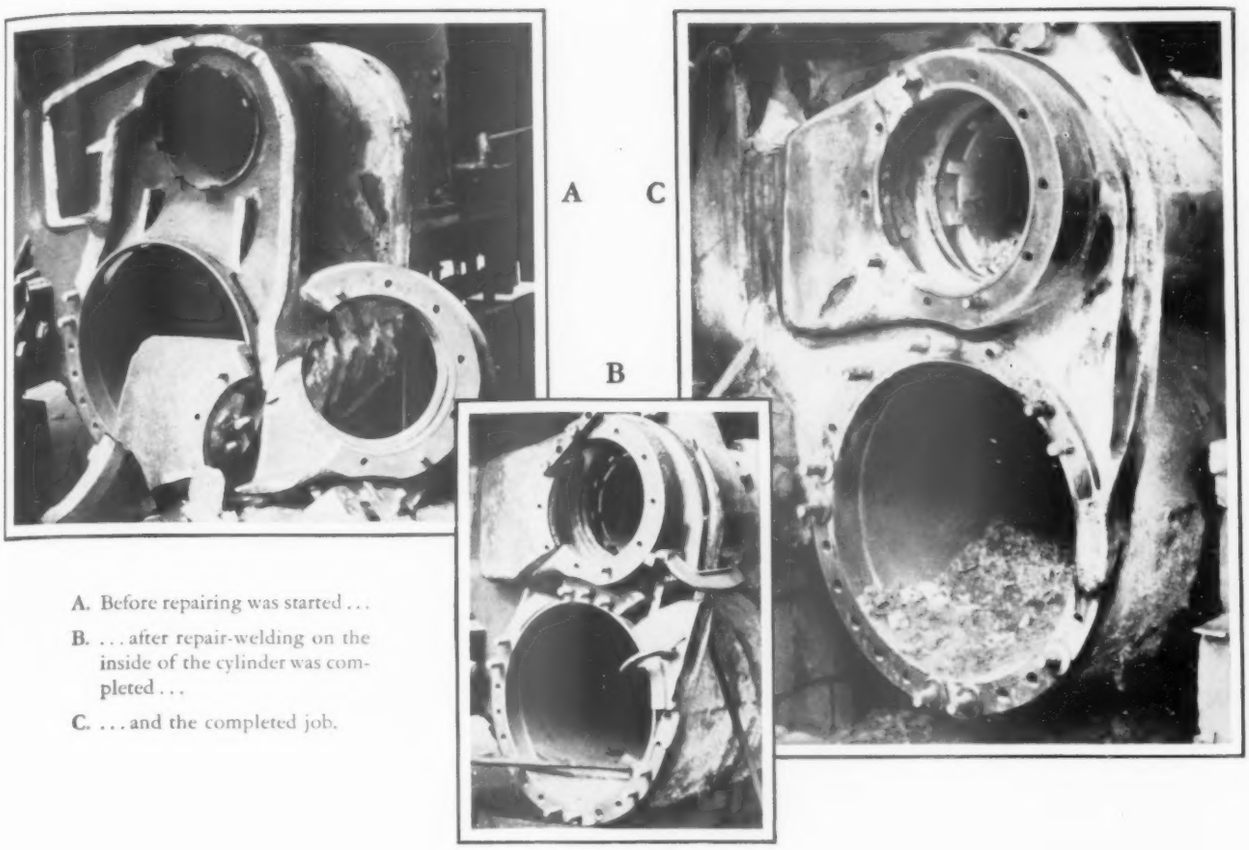
Charles Plummer has purchased the Harry Treadway blacksmith and welding shop, Toledo, Iowa, and will continue its operations. Expansion is planned by the new owner.

Johnny Walker, of the Hughes Tool Co., Houston, Texas, manufacturers of welded oil well digging bits and other welded oil field equipment, recently spent a week in Tulsa, Oklahoma and nearby territory.

The Pacific Electric Railway Company, of Los Angeles, Cal., report the recent purchase and installation in their Long Beach Boulevard welding and repair shops, of four new 300-amp Westinghouse electric welding units. These are the very latest type machines specially built for railroad welding, and are designed to operate from the regular 600-volt trolley line. Part of the machines are to be mounted on trucks for distant line work.

The William Lassar Mfg. Co., 1200 San Fernando Road, Los Angeles, Cal., recently opened for business featuring general welding and machine work of all kinds. Among other work, Mr. Lassar will specialize on the manufacture of a newly patented meat cutting machine on which considerable welding is done. The oxy-acetylene process is employed principally in the shop at present.

The Superior Air Products Company, 132 Malvern Street, Newark, N. J., manufacturers of oxygen and oxygen plant equipment announce that constructions are under way to provide additional floor space and manufacturing facilities. It is expected that an additional floor will be added in the late spring of this year. Mr. Peter Peeff is the manager of the organization.



A. Before repairing was started . . .

B. . . . after repair-welding on the inside of the cylinder was completed . . .

C. . . . and the completed job.

Locomotive cylinder repair-welded with TOBIN BRONZE at a *total* cost of only $257

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

For Oxy-Acetylene Welding	
Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F
For Arc Welding	
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

A locomotive with the fractured cylinder shown in picture "A" was brought into the repair shops of a mid-western railroad in 1929. It was repair-welded with Tobin Bronze and has been in daily service ever since. The welders expressed confidence that the repair would never fail.

A new cylinder would have cost $1,700; repair-welding with Tobin Bronze cost only $257. And *all* costs were figured—preparation, new torch tips, charcoal, gases, Tobin Bronze and overhead. The complex valve ports cast with the cylinder necessitated preheating, although in ordinary work the low melting point of Tobin Bronze makes preheating unnecessary.

The unvarying high quality of Anaconda Copper Alloy Rods is due to the technical experience gained in developing a complete line for low temperature welding—gas and electric. Anaconda Rods are available through leading distributors . . . usually shipped in bulk, but also obtainable in ten-pound packages. For complete information, ask for Publication B-13.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Office: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada, ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

ANACONDA WELDING RODS

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

FOR SALE

For Sale—$3,656.00 worth of equipment and stock. A well paying business established 12 years. You will want to know more about this offer, especially the cash price. Write the Electric Welding Works, 16 W. Haley St., Santa Barbara, Cal.

ONE DOLLAR
WILL INCREASE YOUR EARNING POWER
by bringing you any one of the following guaranteed
FLUX FORMULAS

Cast Iron—Brazing—Copper—High-speed Steel—Aluminum (good for both the cast and sheet metal)—or all for $4.00. With instructions YOU CAN MAKE YOUR OWN fluxes just as hundreds of the most successful welders are doing today who insist on having their fluxes fresh when they need them for the better job.

R. N. Robbins, 38 Winans St., East Orange, N. J.

WANTED TO BUY

Oxygen Cylinders—500 Oxygen Cylinders, recent test, desired. Send full particulars. Address Box 451, The Welding Engineer.

POSITIONS WANTED

Combination Welder—High School graduate, trained in Y. M. C. A. welding school, and Lincoln Electric school. Experienced in fire escape erection and window grills. Know reclaimation and repair. Will accept small salary if there is an opportunity for advancement. Box 457, The Welding Engineer.

Acetylene Welder—Experienced in all metals and electric arc. Steady worker, good references, willing to go any place for a good job. Buell Wheeler, Parsons, Kansas.

Air Liquefaction Plant Engineer, manager and superintendent, thoroughly experienced in production of oxygen and nitrogen; electrolite production of oxygen and hydrogen; acetylene. Proven capability as manager and constructor of large industrial gas plants here and abroad; qualified to conduct plants on thoroughly economical basis and to provide for modern construction and improvements. Will consider connection in U. S. or S. America; excellent references; speak English, German, Spanish. Address Box 454, The Welding Engineer.

Combination Welder—Experienced job shop, production, maintenance, refinery and pipe work. Reasonable salary considered if there is chance of advancement. L. H. Perkins, 4408 North 28th St., Omaha, Neb.

Electrical Engineer with a very thorough knowledge in design and development of electrical welding equipment. Will accept temporary work on a contract basis. Box 456, The Welding Engineer.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of The Welding Engineer, published monthly at Chicago, Illinois, for April 1, 1932.

State of Illinois, County of Cook, ss.

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared H. S. Card, who, having been duly sworn according to law, deposes and says that he is the Editor of The Welding Engineer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, G. H. Mackenzie, Chicago, Illinois; Editor, H. S. Card, Chicago, Illinois; Managing Editor, H. S. Card, Chicago, Illinois; Business Manager, H. S. Card, Chicago, Illinois.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) The Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill.; G. H. Mackenzie, 7321 So. Shore Drive, Chicago, Ill.; H. S. Card, 9709 Vanderpoel Ave., Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is _____ (This information is required from daily publications only.)

H. S. Card, Editor.

Sworn to and subscribed before me this 31st day of March, 1932
(Seal.) R. J. McGarry.
(My commission expires March 1, 1934.)

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